HEATING AND VENTILATING

INCLUDING AIR CONDITIONING

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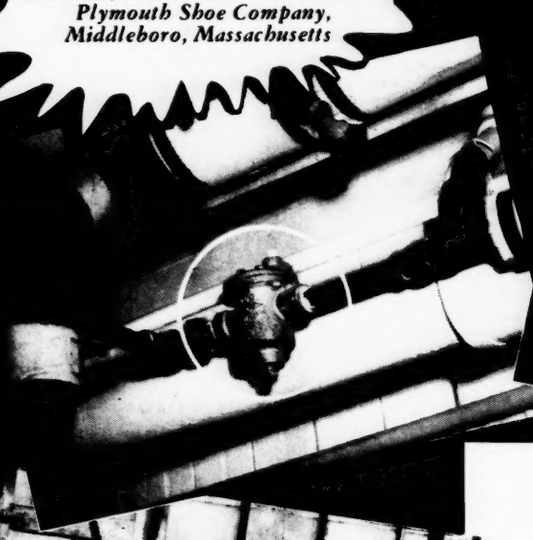

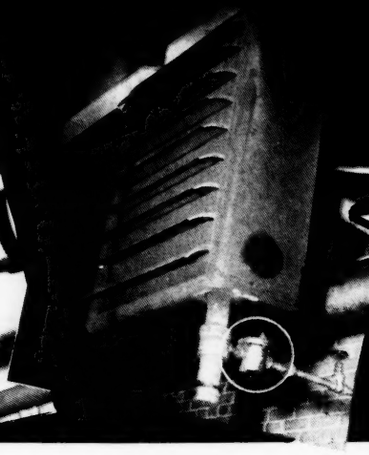

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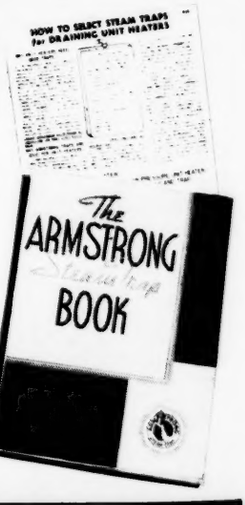

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HEATING AND VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH THE DESIGN AND APPLICATION OF AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION IN BUILDINGS

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THIS MONTH'S COVER

Check-out station in a large retail food market. With the development of packaged air conditioning systems, this type of store is expected to provide an attractive field. For data on steps in the design of air conditioning systems for retail food stores, see page 77.

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Washington News

LORING F. OVERMAN

BACK in January this column, in commenting upon the possible fate of Harry Truman's promise-anything program which won him re-election, observed that much can happen in Washington between the time legislation is introduced and the time for final passage. Specifically, this column said:

"It is not unlikely that some Senators or Congressmen who would vote 'yes' if certain questions were asked tomorrow, might vote 'Nay' three months from now. By that time it will be more apparent whether the President is insistent upon passage of a measure, or whether he is merely speaking for the record. It will be known whether the election upset was really a voters' mandate, or whether the President's electioneering style merely caught the public fancy. More important, members of Congress will know how much they must temper their own views on certain subjects if they are to win support of fellow legislators when their own pet projects come up for consideration."

The three months of Congressional reorganization, hearings, and jockeying have now passed. With them appear to have passed the President's great moment when it appeared that all was his to command. It may not be assumed that much of the program he had in mind will not be enacted, but it seems fairly certain that many of the barbs will be removed.

One thing, apparently, has not changed. The President has not faltered once in his interpretation of the November election as a mandate to junk Taft-Hartley labor regulations, to seek economic controls, to broaden social security and public housing, to raise taxes at the upper income and corporate levels, to push Civil Rights programs, and to inaugurate more government-sponsored activities of various kinds.

Congress Drags Feet

Congress, on the other hand, has seen a lot of things happen since the first of the year. It has seen the threat of inflation assume the proportion of a deflationary trend. It has seen John L. Lewis again throw his weight around when displeased. It has seen its own ranks torn asunder when Congressional toes are stepped on too hard by controversial proposals. As of this moment, while anxious to go along as far as possible with the man responsible for their election, many enthusiastic Fair Deal members of Congress have reached the conclusion that they're going to have to work with others in order to get any part of the Administration program over the hurdles.

An interesting sidelight of the 81st Congress is the part committees are playing. Normally, all of the work of the House and Senate is done in committee rooms, with the recommendation of the committee commonly reflected by the final vote. In other words, approval of a certain piece of legislation by appropriate House and Senate Committees has, in the past, been tantamount to passage of the bill.

Committees Pass Buck

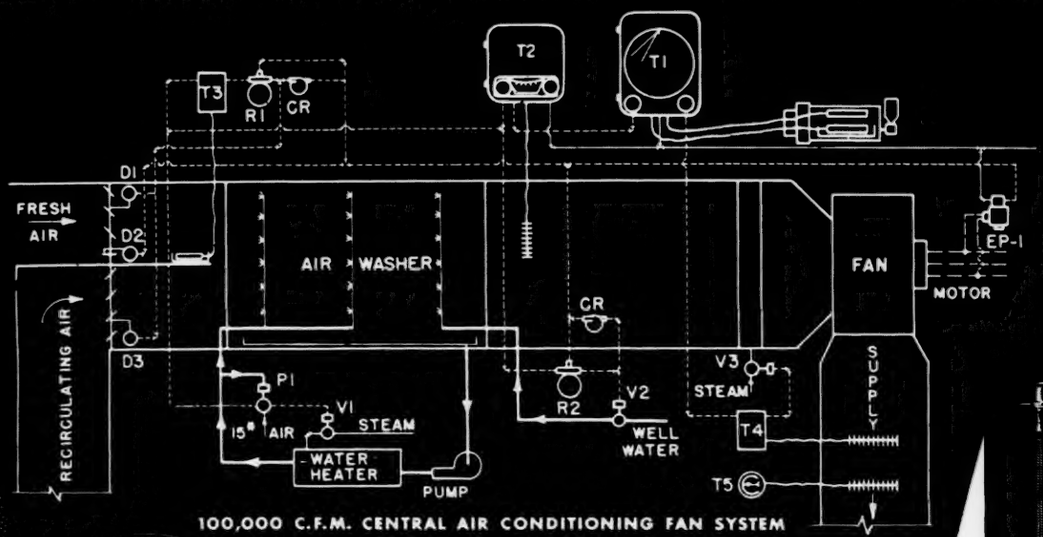
Currently, committees have been opening hearings on controversial measures with a more or less tacit understanding on the part of the majority that the Administration's wishes would be followed. In some instances efforts have been made to limit the length of hearings to a week, or even a matter of days, in order to speed things along. At this point, surprising opposition has often developed in the form of insistence that the hearings be scheduled to accommodate large numbers of witnesses desiring to be heard. Almost without exception, the petitioning witnesses have been in opposition to the measures under discussion.

Throughout the hearings, some have sensed the attitude, "Well, we have to listen to the evidence, but we won't let it change our determination to recommend passage of the measure." Also sensed by observers is the probability that committee members realize that, once on the floor of the House or Senate, the fight is going to start anyway. Therefore, committee members appear to reason, they may as well send the measure along with their blessing—to please Harry—letting the chips fall where they may when the floor showdown comes. So in instance after instance, committee votes have been strictly along party lines—Democrats approving, Republicans contrary-wise.

Liberalization Nevertheless

Thus, while the President didn't get the Taft-Hartley act repealed in three weeks as he had hoped, and while he seems unlikely to get $4 billion more in taxes, or price controls, or allocation authority—he won't come away empty-handed. Observers agree that the new labor law will be more to the liking of labor than management; that a 75c minimum wage and broader Social Security coverage are likely; that public housing will include provision for some 800,000 units; that federal aid to education will get its foot into the Treasury doorway, and that the inevitable result of these and other door-openers will be higher taxes at some future date.

Some idea of what it costs to have Government "do everything" is gleaned from hearings on Social Security proposals, before the House Ways and Means Committee. Social Security Commissioner Arthur J. Altmeyer told committee members that the cost of financing the Administration's broadened old age, survivors and disability insurance program on a pay-as-you-go basis, starting now, would be seven percent of payroll. Currently the rate is 2 percent—1 percent from employers, 1 percent from employees. Since most employers already know who really pays the sums that Government pays out, it might be a good idea to



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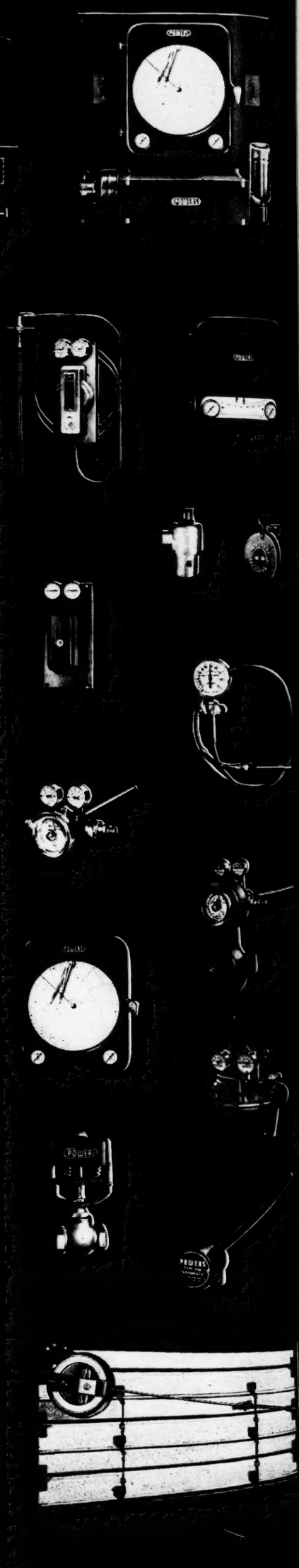


go ahead and raise the payroll deduction to what committee member Robert W. Kean (R-N.J.) called "An honest figure". Employees, too, would then know that the Government pays out what the taxpayers pay in—less administration expenses.

Steel Agreements

It may be good news to some in the heating, ventilating and air conditioning industries to know that steel supply seems to be catching up with demand, although the reasons for this reversed trend may, in turn, be subject to speculation. In any event, some of the industries in the Department of Commerce program for the voluntary allocation of steel no longer require the amounts set aside for them. Readjustment of these voluntary schedules has made it possible to release this unused high priority steel to other industries where demand is still high.

As of March 23, Secretary of Commerce Charles Sawyer reported release of 150,000 tons per month, despite the addition of several new programs, including 950 tons a month for baseboard radiation.

Petroleum Exports

Also of interest to the oil-fired side of the heating industry was the announcement, on March 21, of the easing of export controls over certain liquid petroleum items. This easing reflects an improvement in the supply-demand situation and is in line with the Department of Commerce policy of relaxing export controls as the domestic need decreases. Items which will not be limited by export controls, effective April 1, are crude oil, aviation gasoline, other motor fuel, kerosene, gas oil and distillate fuel oil, residual fuel oil, and blending agents.

Despite this optimism over betterment of the oil supply, the long-range search continues for sources which would make this country independent of foreign supply in the event of a war. Some have not forgotten the time when warplanes flew while householders shivered.

So Washington brass was looking forward with considerable interest to the dedication, on May 8—fourth anniversary of V-E day—of two new coal-to-oil demonstration plants at Louisiana, Mo. Authorized by the Synthetic Fuels Act of 1944, one of the demonstration plants has been completed at a cost of $10,000,000 by the Bureau of Mines, to serve as a proving ground for processes which it is hoped will spur the country to develop a new basic industry.

Synthetic Fuel Plants

The plants, centrally located with respect to the country's major coal fields, were established after a survey of 206 proposed locations. A factor in the selection of Louisiana, Mo., was the availability of facilities of the Army's Missouri Ordnance Works, an ammonia plant. This plant has been loaned to the Bureau of Mines.

The plants will demonstrate the respective merits of two basic processes for converting coal into oil—the direct hydrogenation or Bergius-I.G. Farben process and the gas synthesis or indirect Fischer-Tropsch process. The processes are said to be complementary rather than competitive, the liquid products produced by each ranging from heavy fuel oils to jet fuels and gasoline. (See News of the Month section, this issue.)

Hoover Suggests Research

Dedication of the pilot plants to the proposition that this country can convert its vast coal fields into petroleum products, adds new meaning to the Hoover Commission's recent recommendation that Congress speed the formation of a National Science Foundation to coordinate government financed research. The report points out that the Federal Government spent $625 million in 1947 for research, exclusive of atomic energy. It urges Congress to create the foundation to examine the total scientific research effort of the nation and assess the proper role of the Federal Government; to evaluate the division of research effort and the factors which impede effective national research.

The Senate has passed a bill authorizing formation of the foundation, and the House is considering it. The bill provides that the foundation be administered by a board of 24 members distinguished in the fields of science, education, and public affairs. It provides that the board, together with an over-all director, be appointed by the President, subject to Senatorial confirmation. The President vetoed a previous proposal to form the foundation, principally because it did not permit him to select the director.

Proponents of the project contend that, despite all that has been accomplished, the frontiers of science remain largely unexplored. With such a body in existence, acting as both a stimulator and co-ordinator of experiments and to encourage practical application, it is felt that progress in research fields will be speeded.

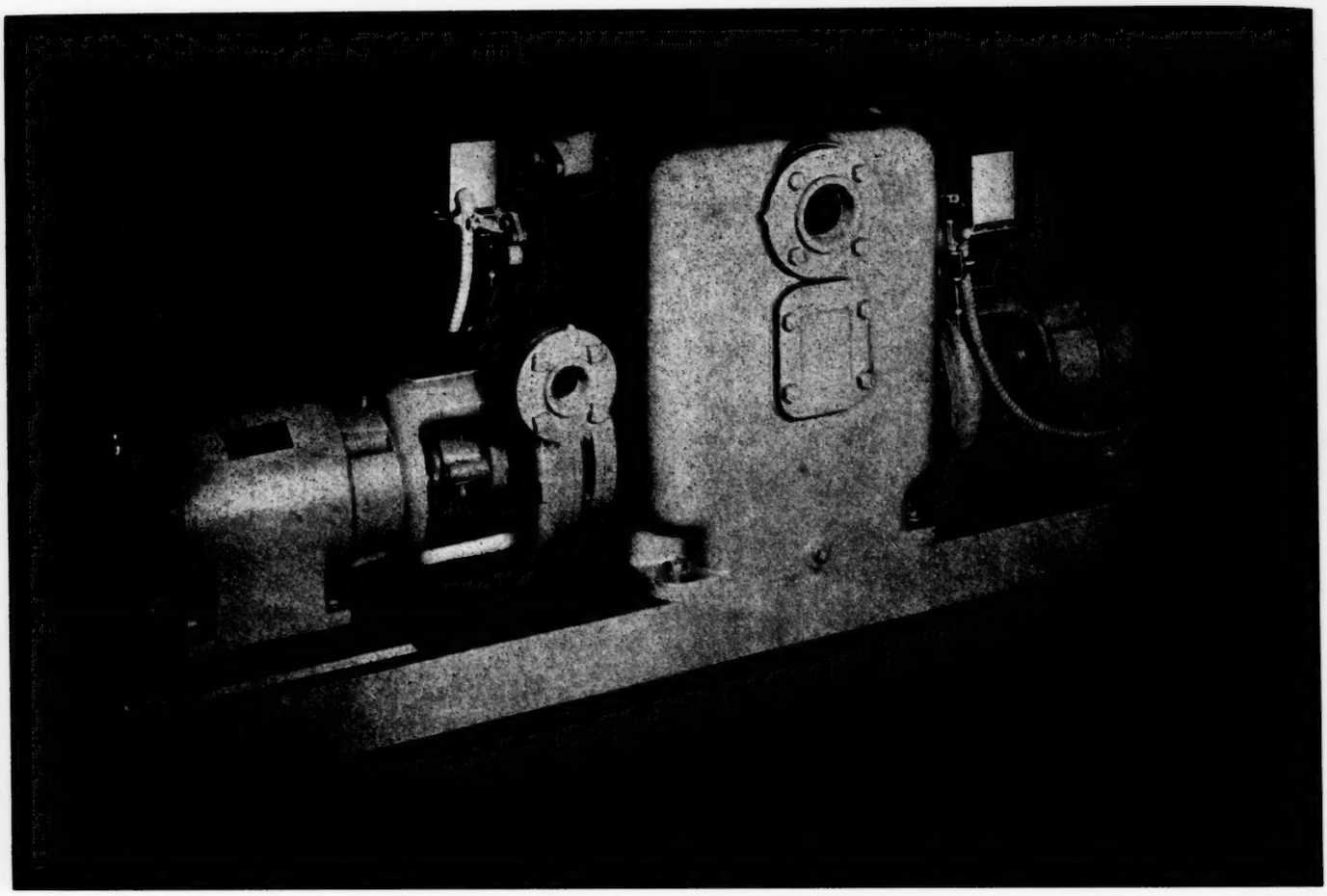
Building Materials

Not so long ago, the availability of lumber and other building materials determined the amount of construction that could be completed. If the same yardstick were applied now, the current year should set new records. More building materials were produced in 1948 than during any previous year on record, the Department of Commerce announced. The composite gain was 5% over 1947, previous record year. Items showing no gain included asphalt prepared roofing, range boilers, warm air furnaces, and structural tile.

Cooperatives Encouraged

Pending expected developments in the fields of housing legislation, the Federal Housing Administration is smoothing the way for those desiring to construct cooperative group housing. Under an amended regulation, it is no longer necessary for sponsors to find a lending institution willing to make a loan before the proposed project can be analyzed by FHA. FHA offices have now been authorized to analyze proposals in advance of the filing of an application for a loan.

MAXIMUM EFFICIENCY FOR STEAM HEATING SYSTEMS ON HEATING, DRYING AND PROCESS WORK.



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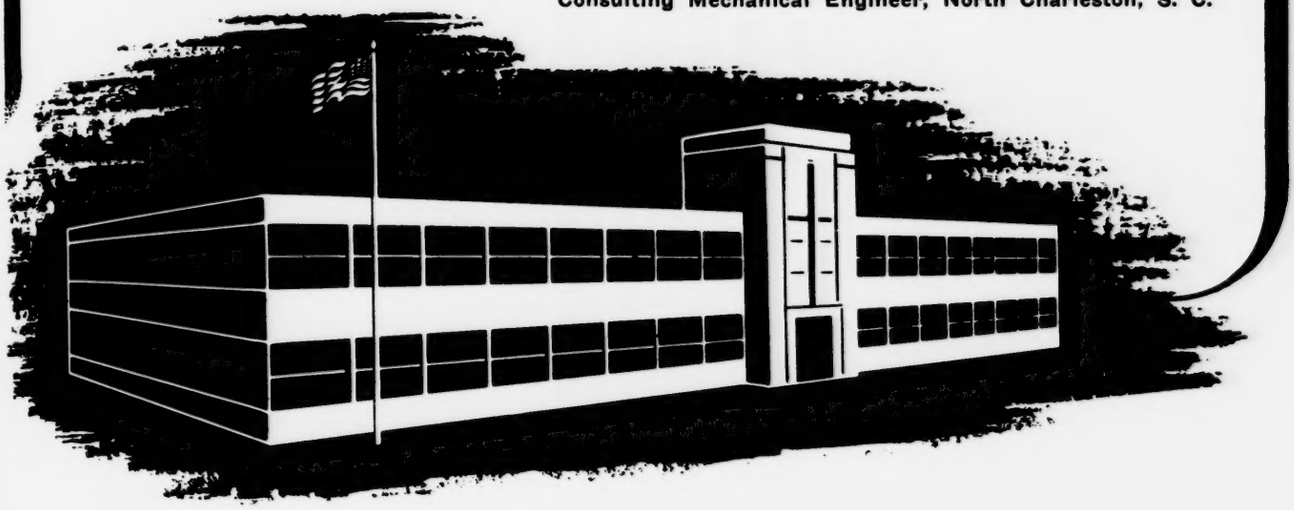
An Approach to School Heating Design

ROBERT H. EMERICK
Consulting Mechanical Engineer, North Charleston, S. C.



Attention is directed to the importance of properly evaluating all the influencing factors at the start of every school heating design, that time and money may not be wasted, and professional reputation affected.

SCHOOLS run to short daily hours, long week-ends, many holidays, occasional night classes and community activities. How to design for these conditions with zoning and automatic control is known. However, the basic problem, whether to use steam, hot water, or warm air is in each case complicated by singular conditions of the case in hand. What we do is chargeable not to our technical skill, but to our judgment. We cannot follow with safety existing conventions, nor use them as an excuse. In short, we are working with public funds, and our choice had better be right.

There is no one rule on which to base a decision, but an analysis of case histories does actually reveal a number of judgment-factors, common to all jobs, that we should observe and weigh carefully before deciding to adopt one medium or another. Six of these factors follow:

(1) Must we design the lowest-cost possible system, and what is it?
(2) Is steam for a kitchen, pool or gymnasium involved, now or in the future?
(3) Is summer cooling a possibility?
(4) Must we tie into an existing heating system?
(5) Are we dealing with a single building or building group? If the latter, are the units widely separated by streets or campus, now or in the future?
(6) What are the architectural restrictions, if any?

As an example of how these factors, sometimes singly, sometimes in concert, can guide a design decision, suppose we examine the case of the Fern Creek Elementary School, at Orlando, Fla.

Designed by L. Alex Hatton, to utilize north lighting to the greatest practical extent, the classrooms are arranged in wings with the control units and boiler house in the center, and completely interconnected by loggias as shown in Fig. 1. The auditorium and administration building, planned for future erection, are delineated with dotted lines. Important design features are observed in the large glass areas set in the northern exposures, and the setting of the floor slab directly on the ground. A cross-sectional view of a typical classroom and the layout, Fig. 2, is notable in that it shows the southern walls to be solid masonry with only small glass areas in the clerestory windows and in the doors.

Because of the cafeteria and kitchen, first thoughts turned toward steam. However, in this case, these services had no influence, for in Orlando heating demands expire long before the end of the school year, and firing a large boiler plant solely for kitchen use was undesirable.

Next studied was warm air because warm air, considered for material and labor, generally is the least costly and satisfactory heat on the present market. However, a study of Fig. 1 and 2, illuminates the difficulties involved in running long ducts around a campus. Architecturally, they simply did not fit. Future extensions to the auditorium in particular with its large demands further complicated warm air design. In view of all circumstances, this medium then was rejected.

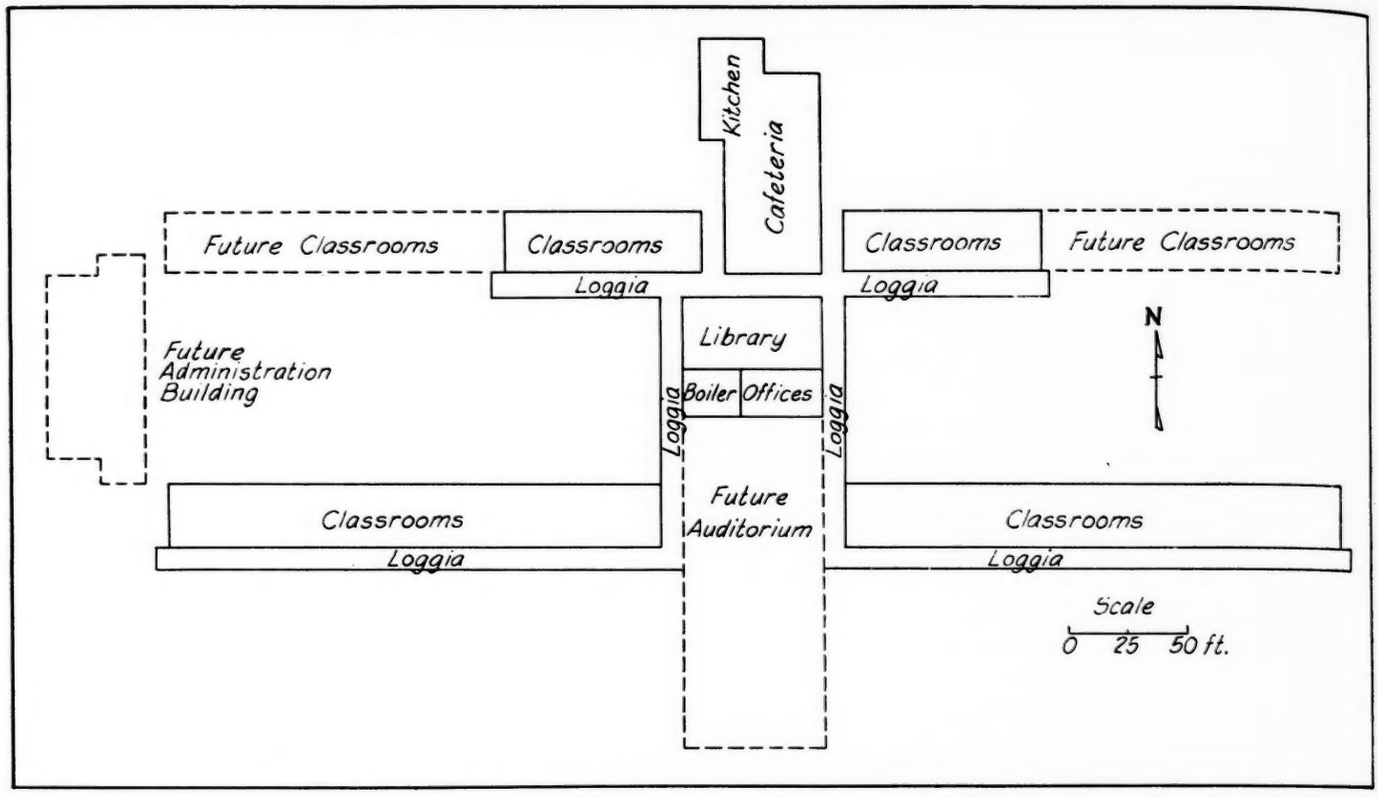


Fig. 1. Unit arrangement at Fern Creek Elementary School, Orlando, Fla.

With the load strictly a heating one, the choice went back to a balancing of the advantages and disadvantages of steam and hot water. Preliminary estimates indicated that costs might be equal. Steam was considered to offer somewhat sharper control, a desirable feature in a climate where temperatures tend to rise swiftly in the forenoon hours, and the fluctuations of solar heat have an immediate effect on the heating load.

A consideration of the future loads indicated that whatever system was selected, the underground piping as far as practicable should be sized from the start for its ultimate capacity. Sizing for steam appeared simpler than arranging for water, primarily because of the number of pumping circuits involved, and the lengthy runs with their attendant friction losses. With steam, trenches were designed for supply and returns only, and while the grading affected the trench depths adversely, the very number of hot water pipes to go underground acted as a deterrent when contemplating the use of this medium.

Weighing the various influences indicates that low pressure steam in this case offers several individual minor advantages, with no particular disadvantages. Consequently the choice of medium was made accordingly and steam was selected.

The Fern Creek job is particularly interesting in its lack of cost influence. Almost always, one system or another will show a decided investment advantage. Our usual expectation is to find warm air, hot water and steam heating showing ascending costs in this order, but the latter two may reverse their order or even cancel out, in special circumstances.

Occasionally our selection problem will appear to be simplified as the result of directives or expressed desires by the controlling authority. For example, a school board for reasons of their own may demand some particular system, or the architect may show some preference. Actually this situation leads the designer into dual dangers.

(1) The correct choice depends on our analysis of various factors, and if we skip this analysis, later troubles and criticisms will come straight to the designer's door. He will deserve what people may say about him, because blindly following instructions is no excuse. The designer is supposed to know and, knowing, correct the guessers, including architects and school boards.

(2) Danger lies in the possibility of having to do a job all over again and perhaps to take in new bids.

Consider the case of the new home economics building for the Walterboro, S. C., High School, Fig. 3. To avoid building a new boiler house, the architect and Board of Education desired to use an existing room in the canning department, 120 ft from the site of the new building.

This was a logical approach, particularly in these days of high building costs, and the fact that plan estimates showed a saving. Selection factors were checked off one by one, and warm air was eliminated mainly because of that 120 ft of school campus; steam lost out to forced circulation hot water on the economic balance. There were no future extensions to consider, no kitchens and no gymnasiums. Two simple loops, with their individual circulators, offered no physical space problem whatever. Pre-bid estimates indicated the system should go in for around $7,000. Drawings were made accordingly, specifications written, and the whole job put out for bids.

Up to this point the entire procedure was strictly

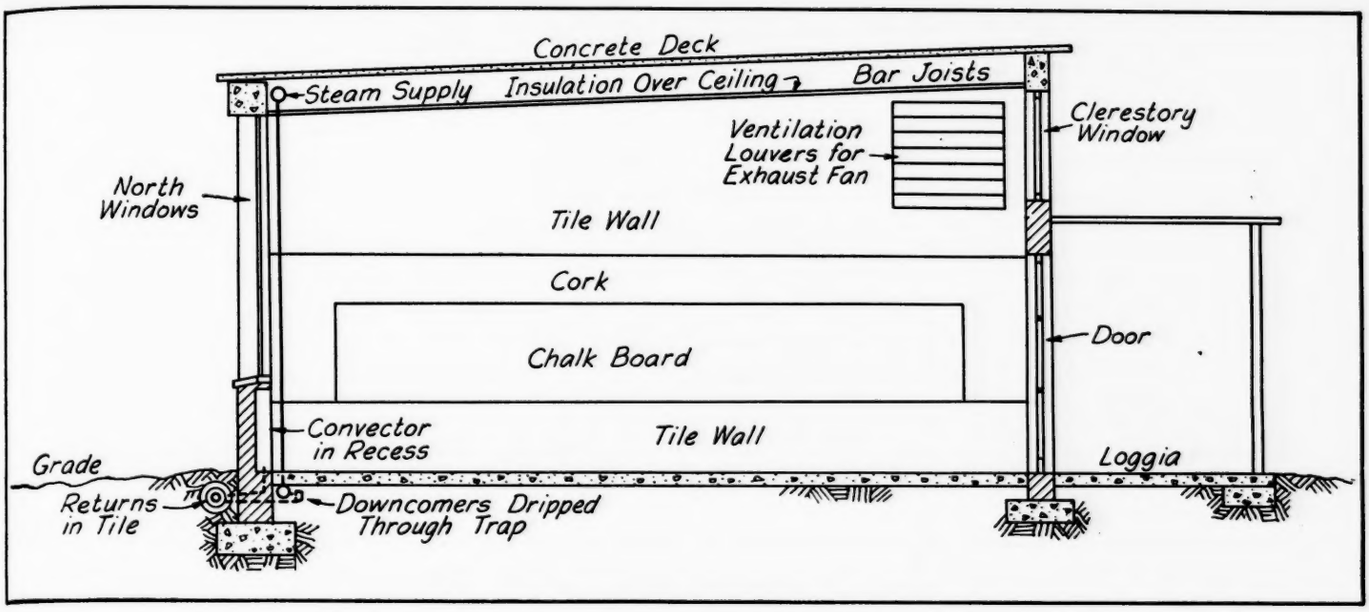


Fig. 2. Cross-section of a typical classroom.

normal, or rather, we should say, it seemed to be normal. As the designing engineer, this writer considered the situation had been correctly analyzed and a proper decision reached.

Unfortunately the situation had not been correctly analyzed, because the expressed desire of higher authority to use an existing building for the boiler house led to the assumption that cost was not the first consideration and actually it was. This job should have been designed from the start on the lowest possible cost basis, but this fact did not jump at the designer until the bids, which ranged from $1,000 to $4,000 higher than the estimates, came in. This divergence was extraordinary for a small job. To say that consternation overwhelmed the authorities is an understatement. School funds always are limited and, with an $8,000 heating system, the board could not afford a building to house the system. Even the original estimate was now called out of line.

There was nothing to do but to redesign the job. The new plan called for a warm air system and, in order to save on ducts, partitions and chimney, all machinery was placed in the long, open attic. As finally installed, two oil-fired air heaters of the horizontal type, set apart the full length of the attic, and each flanked by filters and an axial flow fan, deliver complete comfort to the new building. Each heater serves a thermostatically controlled zone. All ducts are concealed in partitions, with high wall registers in the classrooms and ceiling type diffusers in the corridors. The result esthetically is quite satisfactory, and provides a suitable job in every way. Fig. 4 shows a typical classroom.

And what was the cost? It was less than $4,700. Everybody came out well except the designer. He had to do the job twice and was paid on the revised low price, which was quite what he deserved in view of his failure to analyze the situation correctly at the start.

Moral: never believe all you are told. Always start by presenting the facts regarding the system with the lowest cost possible as the starting point and go on from there.

A school problem frequently met, involves the physical union of a new structure with an old building. In these cases the desirability of using existing equipment if possible, and certainly duplicating the operating system, is immediately evident. However, the old system is not always above reproach, in which event the new specifications should incorporate its thorough rehabilitation. This business of rehabilitation is a

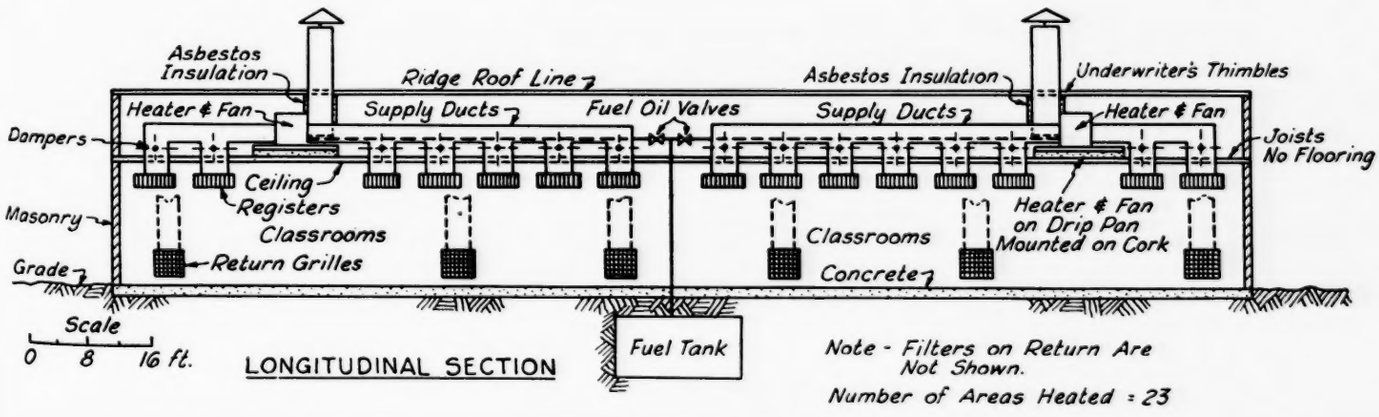


Fig. 3. Heaters in attic design for the Walterboro, S. C., High School.

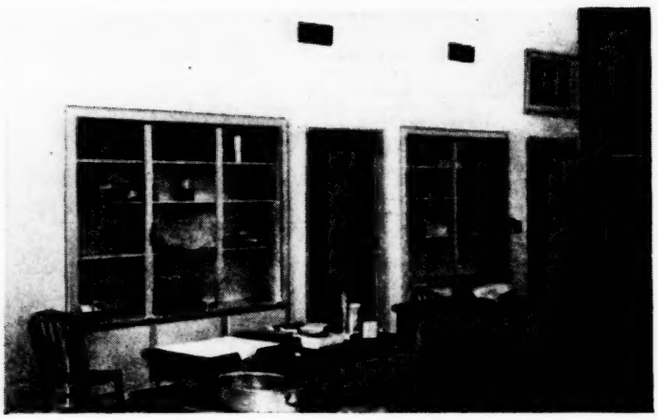


Fig. 4. High wall registers placed in a classroom.

must, for human nature being as forgetful as it is, the designer will hear to the end of his days that the old system worked perfectly until he gummed it up by hooking on some new pipes.

How these improvements are handled in practice is illustrated in the case of the St. Stephens group, at St. Stephens, S. C. Fig. 5 is a plan sketch showing the relationship of the various buildings. New work includes the gymnasium, cafeteria, kitchen, elementary school, and a centralized boiler house.

The existing high school and auditorium are served, far from efficiently, by a one-piece steam system with a return pump in the basement. On the new plans, drawn by Halsey and Cummings, the existing boiler comes out and the system is supplied from the new boiler house.

Specifications for the new work included a section devoted to rebuilding the old system which listed betterments extending all the way from simple radiator valve replacements to a regrading of the steam mains and the hooking in of new drip lines. Bidders were asked to segregate their prices for this part of the work, not with the idea that its accomplishment was doubtful, but to facilitate bookkeeping and to produce a true picture of the new construction cost. All rehabilitation work should be priced separately to keep the costs straight.

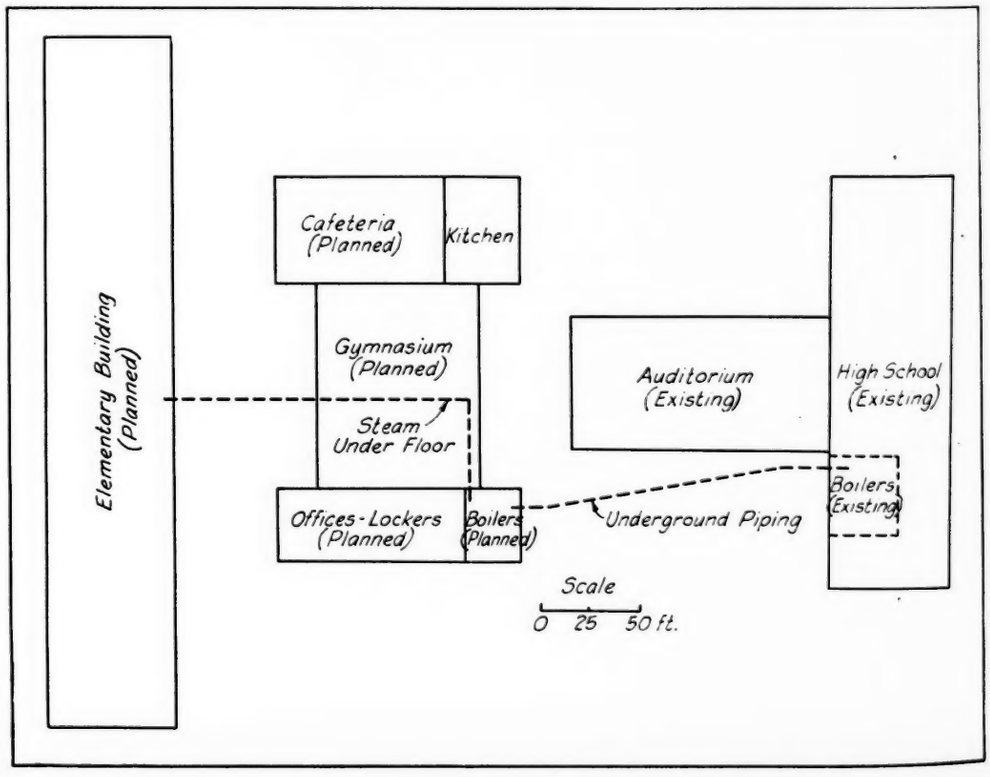


Fig. 5. Group interconnections of the school buildings at St. Stephens, S. C.

This is one of the cases in which a change of existing medium was not indicated by an examination of the factors. Warm air was not desired for the same reasons existing at Fern Creek, and hot water introduced similar pumping and zoning problems. The all-season steam demand by the kitchen plus a great deal of hot water for the large gymnasium, offered additional reasons for a choice of steam.

Conditions are not always so clear cut. For example, Fig. 6, a three-story addition to an existing school in Charleston, S. C., also illustrates that a complete break with existing practices is sometimes the best way to design a job.

The existing building is steam heated, employing a two-pipe system with a stoker-fired boiler. Early studies of the situation discovered that the old boiler room and chimney were too small to accommodate an additional boiler, thereby injecting the need for new boiler space in the plans and destroying the original scheme of concentrating boiler services in one room. Consequently, tying the two plants together introduced unexpected cost items.

The next factor was architectural, while the new plans called for all piping to be concealed in walls and floors, this layout was not practical with steam owing to the probability of drainage problems originating in so large a network of flat piping.

As we now had no great advantage in sight from duplicating the existing system (rather we could expect some trouble) hot water was given preference over steam for this job. The result meant two different types of systems and two boiler rooms although the governing conditions indicated clearly that this was the thing to do.

Warm air was considered and the reasons for not favoring it are interesting. Because of the large volumes required, we faced some knotty problems of

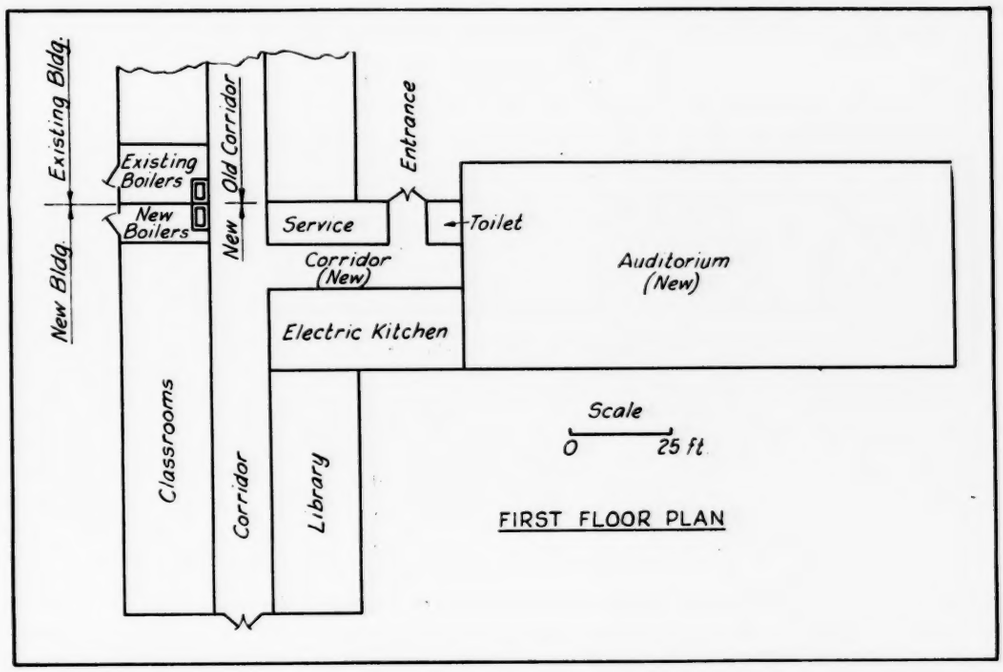


Fig. 6. **Addition to an existing school, Charleston, S. C.**

duct layout. Finding space for ducts was far from easy. The possibility of noise had to be weighed, in view of the long runs and restrictions on duct size, and the verdict was unfavorable. As a final disadvantage the connecting corridors between the old and new structures remain wide open, thereby complicating the air distribution and balance.

There is one special condition that may seem to govern our decisions if our school is located in a large city. This condition is the occasional availability of district steam. Actually, the basic situation is not changed in the least. We are merely concerned with a steam valve and a meter instead of a boiler. We can use the steam as it comes in, or convert it to hot water or warm air—whatever our analysis of the essential factors indicate to be proper. There is ample precedent for whatever we do.

It is now possible to draw some conclusions concerning heating design for schools. Remembering that every job is at the mercy of its own peculiar conditions, we can set down these conclusions as follows:

Warm Air

(a) At the present market, it is likely to offer the cheapest satisfactory design.

(b) If we can hide the ducts or perhaps camouflage them as false beams, system is then architecturally favored.

(c) If we design for a single central plant, then it is not suited for a group of buildings.

Hot Water

(a) It is likely to be the method of heating second lowest in cost.

(b) System can be awkward physically if we have a number of zones or circuits.

(c) It may have no cost advantage over steam if the buildings are widely separated.

(4) It is first choice, if much level or near-level piping is necessary.

Steam

(a) System is likely to involve the highest installation cost.

(b) It is well suited to widely spaced building groups.

(c) It provides sharp control characteristics.

(d) Where kitchens, pools and gymnasiums are concerned it gets extra favorable consideration.

(e) It is difficult to design for if proper grading and drainage cannot be provided.

While these conclusions may not win universal agreement, there is one other conclusion that should. It has to do with the six factors we discussed previously and goes like this: if we fail to identify and properly evaluate *all* the influencing factors at the start of every job, we may discover that a loss of time, money and professional reputation is just around the corner. Getting these facts for every job therefore becomes our first duty.

Radiant Heating Installed in College Building

Three different construction techniques were used for the installation of radiant heating coils at the new $450,000 main building for San Angelo Junior College, San Angelo, Texas. In the two-story structure, which contains 61 rooms, floor coils are used for the auditorium, stage and library. For the auditorium stage, which is 61 ft x 29 ft, the coils were installed between floor screeds and then topped by maple finish flooring.

The system is designed for the use of 114F water at 15F outdoor temperature. Gas-fired boilers supply water both for the radiant system and the convectors that are used in small individual rooms. Three pumps force the water through coils in the separate zones.

George R. Rhine, San Antonio consulting mechanical engineer, designed the heating system which was fabricated at the site and installed by J. P. Bollinger Plumbing & Heating Co., San Angelo. Architects were Maudlin & Lovett and the general contractor was G and E Construction Co., both of San Angelo.

Instrumentation for Field Tests of Panel Heating

D. L. MILLS,* L. J. LATART,* and F. W. HUTCHINSON**

This article is fifth in a series providing performance data on a carefully controlled field installation.

THE science of space heating by means of radiant panels has progressed—through rational analysis combined with laboratory experiment—to a point such that few if any basic questions of design or performance remain unanswered. In contrast with the situation as it existed ten years ago the engineer and contractor of today can design and install floor, wall, or ceiling panels in practically any type of structure by utilizing any of a number of design procedures which have proven their validity through long and extensive use. The questions of today are not "Will it work?" or "How to do it?", but pertain rather to comparisons of systems and to analyses of comparative first and operating costs.

The *science* of panel heating is no longer of particular concern to the contractor or to the engineer; it is well established and has long since proven its worth in many hundreds of successful installations. The *art* of panel heating, however, is yet in the formative stage. What are the practical problems that arise with respect to plastering, to bending tube, to anchoring tube, to spacing and embedding coils? To what extent do occupants going through the normal processes of working and of living alter the heat balance and the unit rating in a panel heated structure? Are there circumstances in practice that lead to marked difference between the results anticipated from tests made in the laboratory and the results realized from a practical installation? These and a great many other questions must be answered in terms of experience and from field tests of ordinary "everyday" panel heating installations.

Test Program

The requirements of a field program for testing panel heating installations are not so simple as might, at first glance, appear likely. Two seemingly contradictory conditions must be met:

(1) The installation for test must be representative of average practice; hence it must be installed, operated, and "used" just as would any other system and without the controls and restrictions that characterize an idealized laboratory program. Preferably the occupants should have no connection with the tests; if they do not know what is being sought they are less likely to influence, consciously or subconsciously, the results. In a laboratory program doors and windows can be left open or kept closed as the conditions of the test may dictate, but in a representative field test such operating variables will be left to the whim of the occupants.

(2) In contrast to the above-described requirement of uncontrolled and representative use of the heated structure, an installation suitable for effective field tests must be equipped with instruments of laboratory accuracy. Of even more importance, the instruments will usually have to be installed at the time the structure is erected, since only when this is done is it possible to obtain the required test data without disturbing normal operations of the system and without interfering with normal occupancy conditions. Some data can, of course, be obtained from *any* installation by means of portable field instruments, but if the tests are to provide information as to what happens in, under, or over the heating panels the required thermocouples — or other temperature-indicating devices — must be built into the system at the time of installation.

Very rarely in practice is it possible to meet these two seemingly contradictory requirements — first, a completely average and representative field installation, and second, instrumentation sufficiently complete and accurate to permit laboratory control of the field tests.

To the authors' knowledge the only existing struc-

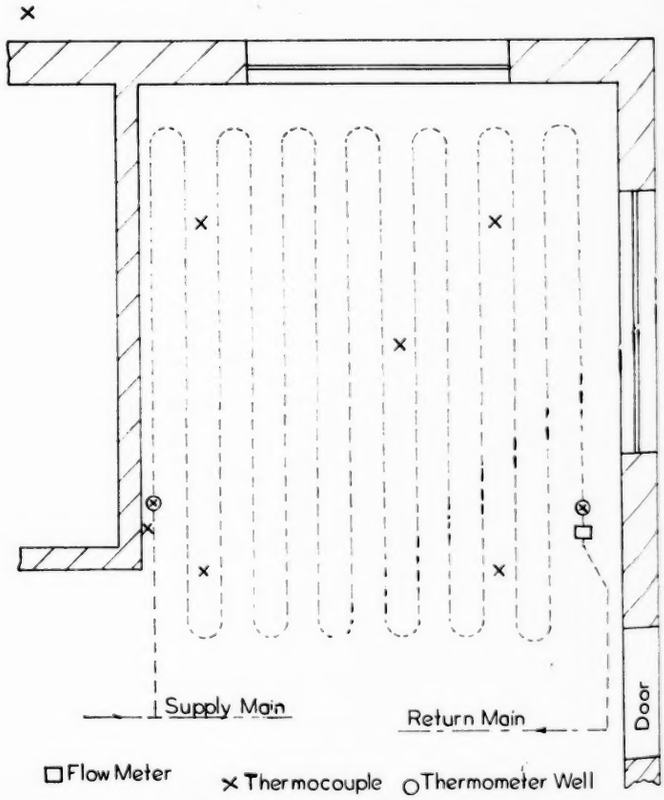


Fig. 1. Plan of typical room.

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ture which meets the requirements outlined in the above discussion is the building which was used for the tests which are described in this article. One other field laboratory in the United States—located on the Housing Research Campus of Purdue University—partially meets the conditions, but has not been tested under conditions of normal occupancy and therefore partakes more of the characteristic of a laboratory than of a representative field installation. By a fortunate combination of circumstances the building in which the work reported here is being done conforms exactly to the specifications for practical field tests.

Revere Metallurgical Laboratory

The structure in question was erected in 1947 to provide additional facilities for the metallurgical section of the research department of Revere Copper and Brass Incorporated. It is 25 ft by 60 ft with an 11 ft 4 in. hung ceiling and is divided by partitions into a group of rooms which are in day-to-day use by metallurgists, chemists, and others who regard the building as their working space and have neither concern for, nor interest in, the heating tests which are being conducted in the building; under all circumstances the heating system operates to provide conditions which the occupants consider comfortable by their *own* definition. As in all such structures this means that some rooms are kept at higher air temperatures than others, according to the personal preferences of the people who work there.

At the time of erection it was decided to build into the metallurgical laboratory a series of different types of heating panels for use in comparative field tests and to equip the entire systems with all instruments necessary for obtaining complete performance records of individual panels and of groups of panels. A detailed description of the sizes and types of panels installed was published in an article[1] written at the time the building was under construction.

During installation of the panels by an independent heating contractor analyses were made of the effectiveness of various methods for fabricating sinuous coils from copper tube, for putting the coils in place (in the ceiling-heated section), and for plastering in the coils. Reports of these field studies were published shortly after the work was done.[2 3]

Preliminary tests were made of various sections of the heating system during the early winter months of 1948. These tests served as a check on the instrumentation and led to minor changes which permitted greater stability of control and more rapid recording of test data. Results from the early 1949 tests were not published, since the structure had only recently been occupied and question may properly have arisen as to whether or not the transient heat-up interval was over and steady state equilibrium established.

During the 1948-1949 heating season a comprehensive test program has been under way and will be continued until the end of the season. Each group of tests which has been conducted has been repeated for the same load conditions and re-run at different loads so the results as published are representative of recurring states in the system. The particular projects selected for investigation during this test season were as follows:

(1) To determine the rating of floor panels under standard operating conditions as actually experienced in practice and to compare the test results with the ratings for the same conditions as calculated from laboratory data;

(2) To investigate the influence of depth of bury of coils in a concrete floor slab on uniformity of surface temperature across the slab and to investigate the influence of varying load—at fixed depth of bury—on uniformity of surface temperature;

(3) To determine the average fraction of heat input to a floor panel that is lost from the underside of the panel and to investigate the rate of rear loss as a function of changing load on the system, and

(4) To determine the pattern of heat flow through floor panels (embedded in concrete) as a function of both load and depth of bury of the tubes.

The first project—rating of floor panels—is one of major interest and concern to the designer since claims have frequently been made that ratings up to three times the calculated value are obtained from actual installations. To the authors' knowledge no substantiating data have ever been published for such ratings, but technical folklore contains repeated references to such "Paul Bunyanish" installations. For the most part such references seem to be based on cases where panels carry design loads at less than design surface temperature; where this occurs the explanation is obviously one of overdesign, but it is by no means evident that the error is in over-rating of panels rather than over-rating of the heating load. Because of the

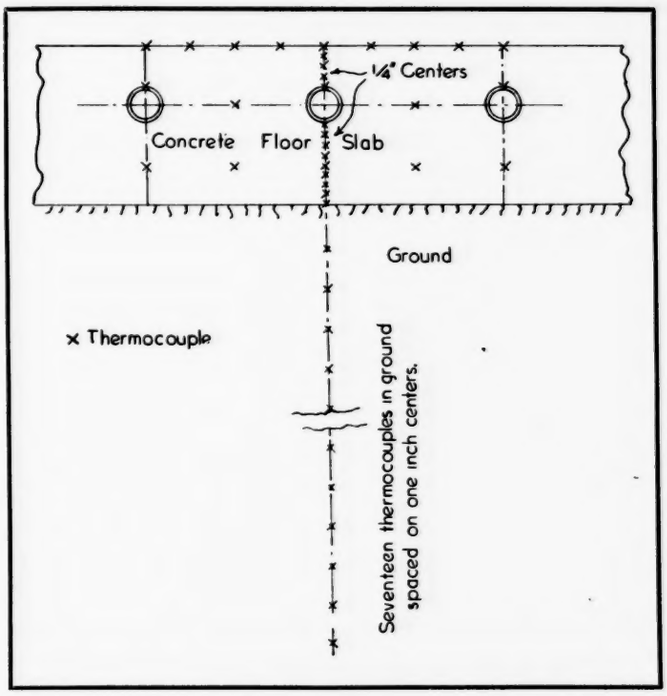

Fig. 2. Typical thermocouple arrangement.

[1] Panel Heating with Copper Tubing: Experiment in Practice, by D. L. Mills and L. J. LaTart, HEATING AND VENTILATING, October, 1947.
[2] Fabrication of Heating Coils, by D. L. Mills and L. J. LaTart, HEATING AND VENTILATING, November, 1947.
[3] Embedding Coils in Radiant Heating Panels, by D. L. Mills and L. J. LaTart, HEATING AND VENTILATING, December, 1947.

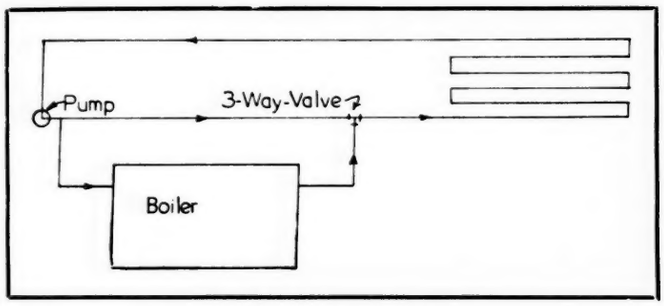

Fig. 3. Schematic flow diagram.

vital practical importance of this subject it was selected as the first one to be investigated even though it would more logically follow the project on rear losses. Qualitative results on floor panel ratings have been presented in a recent article.[4] Present indications —from work on the third project—are that the conclusions deduced in that article can be even more rigorously applied than was there indicated. Thus, available data (to be published in a following article) indicate that rear losses from uninsulated concrete floor panels located on a gravel fill exceed the assumed value of 10%, so that the actual rating of floor panels is somewhat less than the values given in the earlier article. This fact sharpens the warning—given at that time—that all published experimental data, whether from laboratory or from practical installation, indicate that *a floor panel operating at 85F should not be designed for an output in excess of approximately 40 Btu per square foot per hour.*

Test work on the second, third, and fourth projects has now been finished and results, together with original data, will be given in subsequent articles of this series. Before beginning presentation of the test results it will be well for the reader to visualize the systems which were tested (in three separate rooms) and to familiarize himself with the method of instrumentation. The authors are firm in their belief that progress in panel heating, as in other fields of engineering, requires presentation of data which have been obtained under closely specified and reproducible conditions. In field tests, occupancy conditions cannot, of course, be reproduced but the general conditions of each test *can* be reproduced, and the method of instrumentation can be so clearly specified that each reader can form his own judgment as to the validity of the data and the aptness of the conclusions.

Instrumentation

Fig. 1 shows a typical floor plan for one of the three rooms in which the floor panels are located which were used during the 1948-1949 tests. In these rooms all floor panels are of the sinuous coil type using ¾-in. nominal diameter copper tube (⅞-in. actual O.D.) placed on 9-in. centers. The coils in one room are embedded so that the distance from top of tube to concrete surface is ½ inch; in the other two rooms respective depths of bury are 1 inch and 2 inches—in each case from top of tube (*not* centerline).

As shown in Fig. 1, thermocouples (x) are located just under the surface of the concrete at the center points of the four quadrants of the room and at room center. Shielded thermocouples are installed in outside and inside air and thermocouples are also located in thermometer wells in the supply and return piping to permit continuous recording of water temperatures entering and leaving the individual coil. Calibrated thermometers are also located in the thermometer wells and a flowmeter is used for determining the flow rate through the individual coil.

A 16-point electronic recorder permits maintenance of continuous temperature records over an extended period prior to the start of each test and throughout the test period. By connecting selected thermocouples to the recorder, variations in conditions with changing load can be observed and assurance attained that steady state exists at the start of any selected test period. During test an extensive control board permits manual switching of various groups of 16 thermocouples to or from the recorder.

Fig. 2 shows in simplified form the flow circuit for each of the systems. Water is maintained at a selected and fixed temperature in the boiler. Flow to the heating panel is continuous and the supply water temperature is established by blending return water with hot water from the boiler by means of a three-way valve. In order to eliminate the influence of slight changes in supply water temperature due to minor "hunting" action of the control system, the flow rate and supply temperature are fixed at the start of each test period; since tests are run only during conditions of steady state (excepting only such tests as are designed to investigate the influence of transience) this procedure is sound and accurate.

A cross-section through the slab in the room with one-inch depth of tube bury is shown in Fig. 3. The "Xmas tree" thermocouple arrangement shown in this cross-section is representative of the type of thermocouple installation which has been provided near the center of the heating panel in each of the three rooms that are used for test purposes. As shown in the drawing, thermocouples permit determination of the temperatures just under the surface of the slab along a line normal to the direction of the heating tubes.

A second thermocouple series extends vertically downward from the floor surface through a tube and to a depth of more than 17 inches in the earth below the tube; this series permits determination of the vertical temperature gradient in the concrete slab above and below the tube and for a sufficient depth into the earth to permit realization of a straight line earth gradient.

A third network of thermocouples is located in the concrete slab and is used for determining temperatures to permit plotting isothermals (constant temperature lines) in the main mass of the slab. A large number of "exploring" thermocouples are also available to permit detailed checking of surface temperatures.

Subsequent articles in this series will present test data and conclusions regarding various design factors.

[4]Tests show limits in Rating Floor Panels, by D. L. Mills, L. J. LaTart, and F. W. Hutchinson, HEATING AND VENTILATING, January, 1949.

Automatic Dehumidification of Vented Enclosures

MAX F. MUELLER
The Davison Chemical Corp., Baltimore, Md.

Using the sun's heat to reactivate silica gel through which the air of an enclosure is forced by natural expansion and contraction is the principle behind the Solar Radiation Breather, a device developed for Army Ordnance to preserve materiel. Results of three years of testing are described.

DEHUMIDIFICATION has, in recent years, become widely accepted as an economical and practical method of preventing corrosion and other forms of moisture damage. The dehumidification of an atmosphere, using a solid desiccant, consists essentially of bringing air, containing water vapor at a certain partial pressure, into contact with a surface, the water on which is at a lower vapor pressure. The two components tend to approach psychrometric equilibrium with one another by transferring moisture from the higher partial pressure air to the lower partial pressure surface. This phenomenon is known as adsorption, and in this case the net result is a reduction in the moisture content of the air. The dehumidification process is normally designed to produce a preservation atmosphere in the neighborhood of 30% R.H.

The application of desiccant type dehumidification may be by static or dynamic means. For static application, a quantity of activated desiccant, such as silica gel, is placed in the space to be dehumidified. The initial charge must be sufficient not only to reduce the relative humidity of the air but also to remove water from the stored materials so that they too are in equilibrium with the desired humidity level.

In dynamic dehumidification, as the name implies, machinery is employed to remove moisture from a given space. In the usual arrangement, air is drawn from the space to be dehumidified by a blower and forced through a bed of desiccant, where it is dehumidified. The dried air is returned to the space, where it collects additional moisture before again being recirculated through the machine. When the desiccant in the dynamic unit is exhausted, it is automatically reactivated.

Larger spaces, such as ships and warehouses, are being dehumidified by means of desiccant machines. Smaller spaces up to, say, 4000 to 5000 cu ft in volume can be treated by the static method. No additional desiccant beyond the initial charge will be required in the latter case if the space is hermetically sealed, since no further moisture can enter, hence protection of the stored materials is obtained as long as the container remains tight. If the container, or barrier, is subjected to fluctuations in ambient pressure and temperature, then a variable pressure will occur inside the space and it is necessary that the walls of the container be of sufficient strength to withstand these conditions. This necessitates the use of a sturdy and expensive enclosure.

To utilize lighter and cheaper construction, the container may be vented to permit a flow of air into and out of the enclosure and prevent the establishment of pressure differentials between the enclosed space and the outside atmosphere. This flow is termed breathing, and its magnitude and rate depend upon the range and rate of atmospheric pressure and temperature change. A dehumidified container, which is vented to the air, will eventually come to equilibrium with the humidity of the surrounding atmosphere, however, since the air breathed in will normally be wet, humid air. To prevent this decrement of the dehumidified atmosphere, the incoming air may be passed through a breather containing a bed of desiccant, thus removing the water from it. A simple breather of this type would become saturated with water and require periodic replacement. To avoid excessive servicing the desiccant would have to be reactivated in place, preferably by automatic means.

Automatic Reactivation

To meet this situation, a breather known as the Solar Radiation Breather was designed by The Davison Chemical Corp. for the Ordnance Department, U. S. Army, for use as protection of dehumidified containers. The theory of operation of this breather has been described in detail in *Chemical*

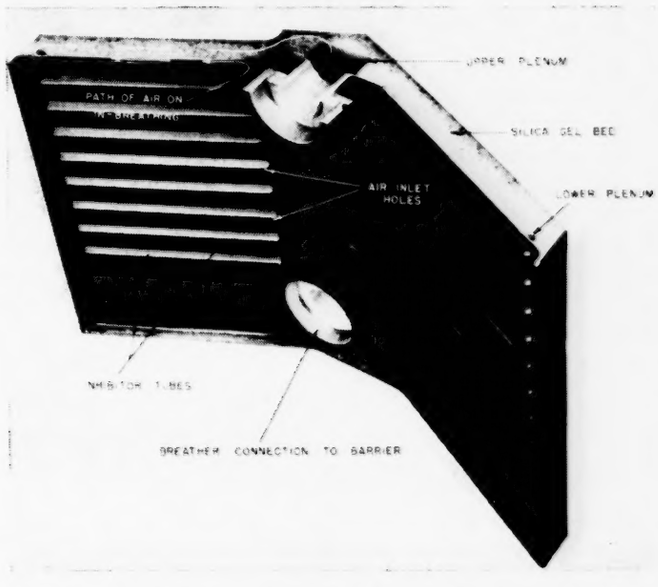

Fig. 1. Moisture is removed from in-breathed air by the silica gel in the Solar Radiation Breather. The desiccant is reactivated by solar radiation when out-breathing occurs.

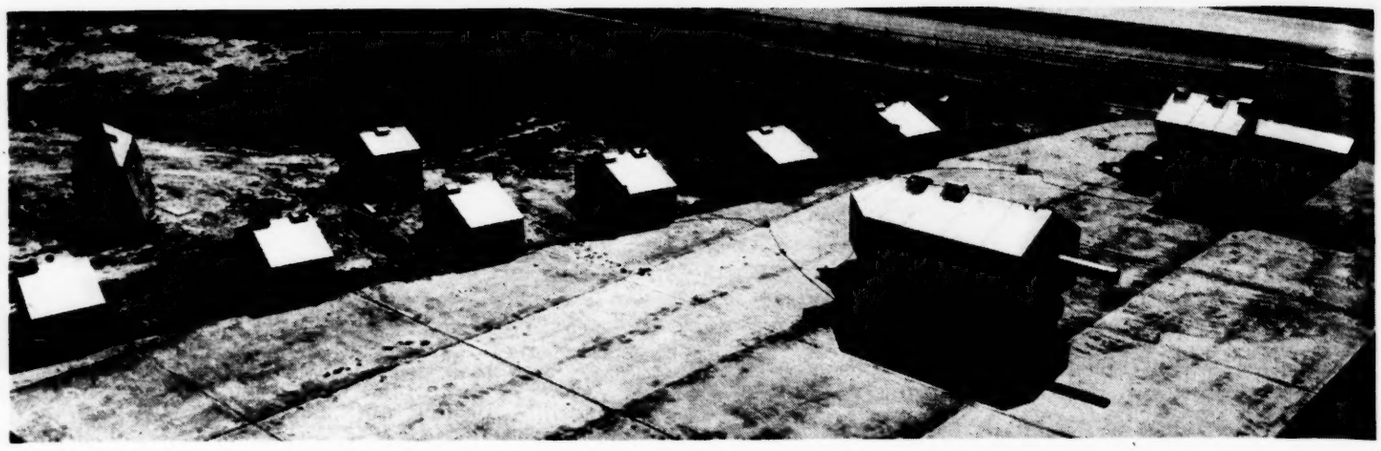

Fig. 2. Containers are equipped with accurate recording instruments to obtain satisfactory psychrometric data at elaborate exposure sites. One such test site is illustrated.

and Engineering News (1945). Briefly, the breather is designed to dry the air breathed into an enclosure under any conceivable natural storage condition by forcing the air to pass through a bed of silica gel. Thus, only dry air can enter during in-breathing.

Solar radiation is utilized during the out-breathing cycle for activation of the silica gel. The exposed surfaces of the breather are finished in a dull black, having a high thermal absorptivity, hence the solar radiation incident on the surfaces will produce a relatively high surface temperature. The silica gel bed normal to the solar rays is only 1 in. thick and will be rapidly heated because aluminum, the material of construction of the breather, has high thermal conductivity. At the same time the air within the enclosure is being heated, which causes it to expand, and a flow of dry air out through the breather results. The water in the silica gel is driven from the capillaries and is picked up and swept out of the breather by the flow of warm, dry air from the container, thus activating the silica gel and preparing it for the next in-breathing operation.

Normally, the silica gel in a breather of this type which has an opening to the atmosphere will adsorb moisture by infiltration from the surrounding air even when there is no flow through the breather. To minimize this infiltration, a series of long narrow tubes has been incorporated in the breather design because this type of device is known to inhibit the passage of moisture vapor due to diffusion.

The breather itself resembles an open inverted book, as shown in the cutaway photograph, Fig. 1. The model shown contains about 12 lb of silica gel.

Test Program

An extensive test program was established late in 1945 to evaluate the outlined theory of operation. Basically, the program was designed to answer two equally important questions.

(1) Will the Solar Radiation Breather reactivate itself?

(2) Will the Solar Radiation Breather protect a tight, correctly dehumidified space?

Both of these must be answered in the affirmative if the breather is to prove of practical value.

A view of one of the test sites is shown in Fig. 2, which depicts ten barriers or enclosures of different sizes and shapes. The walls of the barriers are constructed of thin aluminum sheets welded together, and the enclosed space is vented to the atmosphere through a solar breather which may be seen on the top of each container. These packs are loaded with equipment being preserved and the contents have been predried to equilibrium with 30% R.H. Each test unit is equipped with recording psychrometric instruments so that continuous dry bulb and dew point temperatures are obtained. From these, the relative humidity in each container may be calculated.

As normally applied to a storage container, the Solar Radiation Breather would be filled with freshly reactivated silica gel. It was anticipated that during the early months of operation the silica gel would adsorb more water than it loses through activation, thus the total weight of the gel and its adsorbed moisture would increase monthly. This process should continue until the breather has come into equilibrium between the humid weather conditions and the dry condition in the pack. From that time on, the total weight of water in the gel should vary only with weather conditions.

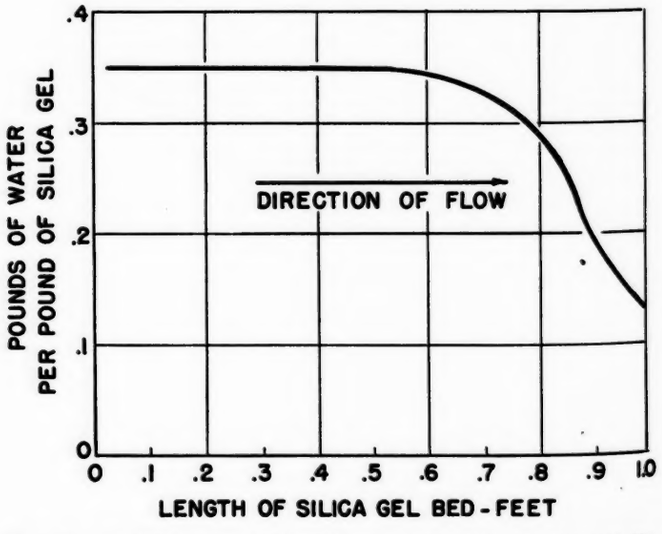

Fig. 3. A desiccant bed will produce this characteristic water distribution curve when humid air is passed through it.

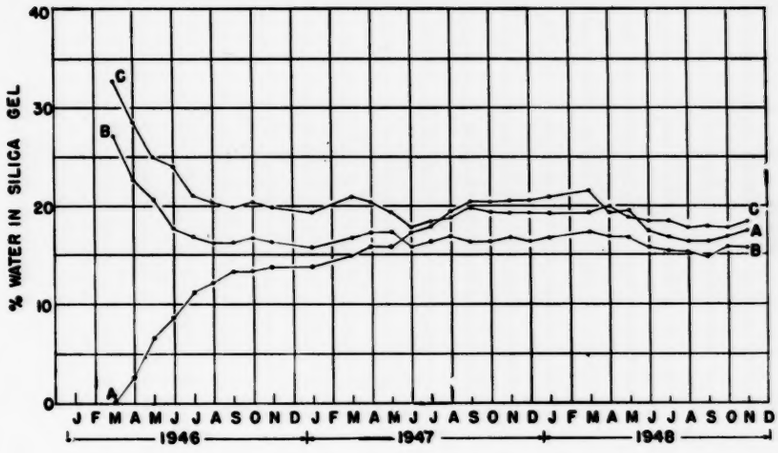

Fig. 4. The water contents of Solar Radiation Breathers equalize and hold fairly constant thereafter indefinitely.

To eliminate waiting through this period of attaining equilibrium, it was decided to preload some of the breathers with the amount of moisture that they would be expected to have when equilibrium would be reached in normal operation.

The amount of water picked up by the gel is a function of the humidity in the air as it passes the particular particle of silica gel, and there will be a much higher concentration of water in the gel at the weather end of the unit than at the end connected to the pack. The resulting distribution of water through the bed, considering in-breathing only over the expected diurnal interval, may be plotted and would be similar to the curve shown in Fig. 3. This is the characteristic distribution obtained with outside air at 80% R.H. and inside air at 30% R.H. and has been checked independently by the method of calculation given by Hougen and Marshall in *Chemical Engineering Progress* (1947). Similar curves may be obtained for all the ambient conditions that a breather might encounter.

During out-breathing, reactivation or desorbtion produces a different set of conditions, and many factors produce a complex situation. It would be entirely impractical to attempt to calculate the ultimate distribution of water through the bed of the breather, and only an estimate can be made of the amount of water that should be preloaded for test purposes. Integrating the area under the curve given in Fig. 3 serves as a basis for a logical preloading of the breather, although it is emphasized that this is only a rough approximation of anticipated values.

Certain of the test breathers were preloaded by connecting a small 15-cfm blower to the outlet of the breather and drawing weather air through until the effluent dew point was raised to a point corresponding to a 30% humidity at the ambient temperature.

Results of Breather Tests

The amount of water in the silica gel in each test breather was determined monthly by removing the unit from the container and weighing it. The breather was handled very carefully at these times to avoid disturbing the particles of gel more than necessary.

Fig. 4 illustrates characteristic data chosen from many tests. Curve "A" represents the data from a breather containing active silica gel with no preloading at the start of the test. As expected, during the first few months the water content of the silica gel in the breather increased in more or less constant monthly increments until the concentration of water was in the neighborhood of 0.19 lb per pound of desiccant (19%) at which time the curve leveled off and has since remained fairly constant. The curve labeled "B" shows the data obtained from a breather which was partially loaded with water to a concentration of 0.27 lb of water per pound of desiccant in accordance with the previous discussion. In this case, after an initial drop, the average water concentration in the silica gel bed has remained fairly constant throughout the duration of the test, although the concentration curves throughout the bed have undoubtedly assumed many shapes and forms during the period of the test.

Several breathers were purposely overloaded with water at the start of the test and curve "C" illustrates the results from one of these. Note the rapid reactivation which occurred during the early months of the test and the gradual leveling off at about the same general location as the other two breathers. These data, which are characteristic of many obtained during the test program, indicate that the Solar Radiation Breather will operate as designed.

Psychrometric Conditions in Containers

Of equal importance is the consideration of whether the Solar Radiation Breather will hold the desired humidity level within the container over long periods of time. Before the results from psychrometric tests made to determine this factor could be relied upon, it was necessary to be certain that the containers were tight, since leaks of any kind would materially affect the results obtained. Packs under test were repaired, where necessary, until the leakage at 3 in. w.g. pressure was reduced to a maximum of 0.25 cu ft per hour per 100 cu ft of container volume. This arbitrarily chosen figure was found to permit satisfactory psychrometric data to be obtained on the subsequent tests.

After studying and discarding many ways of presenting temperature and humidity data obtained over extended periods of time it was determined that the most valuable long range data could be shown as weekly averages on a chart where the abscissa is percent relative humidity and the ordinate is dew point temperature. On this type of psychrometric chart, lines of constant dry bulb temperature appear as contour lines sloping upward to the right. The psychrometric condition of the pack atmosphere can thus be followed from month to month and from season to season without the chart becoming cumbersome.

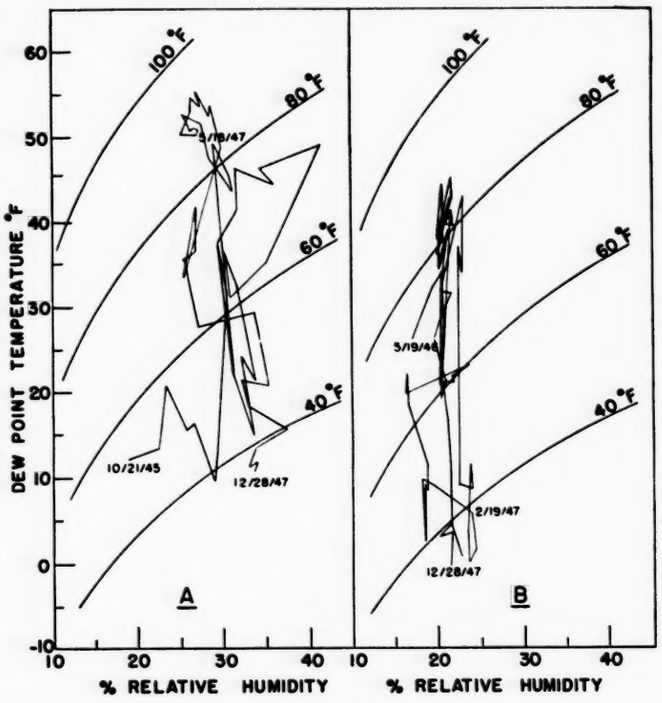

Fig. 5. Weekly average relative humidities remained within a narrow band over a two year period in tight containers protected by Solar Radiation Breathers.

Fig. 5 presents the results from two characteristic packs, the data extending over a two year period. The pack represented by the data in the left block of the chart, labeled A, contains no commercial desiccant other than that in the breather, and depends on the desiccant value of the stored materials to maintain an isopsychric condition (a uniform percent humidity at all temperature levels). The initial data were taken from this pack in October of 1945 and the first weekly average plotted is shown as 10/21/45. Previous to the start of the test the pack had been predried to a point where the contents were in equilibrium with a 20% relative humidity. Shortly after this (December, 1945) the equilibrium humidity was artificially raised to 30%. As the seasons progressed and the temperature became gradually warmer, water was driven from the materials into the atmosphere (desorbed) with the result that by late May of 1946 the dew point temperature had risen from 10F to 46F. This change in dew point temperature was the net effect of a rise in average dry bulb temperature from 40F to 80F.

With the return of colder weather the dry bulb temperature receded to its former level, with a corresponding drop in dew point temperature. The cycle was repeated during 1947 with a peak average temperature of 95F in August, and an accompanying rise of dew point temperature to 55F. During the entire period a fairly constant average relative humidity was maintained. As the dry bulb temperatures decreased again during the winter season, a simultaneous counter-balancing drop in dew point temperatures took place, so that again a uniform percent relative humidity was maintained. The data for the entire year of 1947 (the second year) discloses a maximum fluctuation of average humidity during the entire year of only 11%.

The data from a second container, shown in Section B of Fig. 5, repeat, in general, these same variations within an even narrower band of relative humidity. This unit contained 50 lb of silica gel in the pack with the stored materials which increased the desiccant-volume ratio of the space. The additional desiccant value in this container has added to the flywheel action to reduce the daily variations of relative humidity.

The data shown on Fig. 5 are characteristic of unit containers stored out of doors in a temperate climate and have been chosen from many such tests. It may be observed that the results obtained during the first full year's operations were more erratic than those for the second full year. This is due to the extremely slow attainment of equilibrium and the long term redistribution of residual water among the various components of the packs.

The data from the containers shown, which are characteristic of many such tests, indicate that the Solar Radiation Breather will effectively maintain the desired humidity level within a container.

The design of the breather bed, being long and narrow, is such that channeling should not be encountered. An important factor in assuring good distribution in adsorbent beds is the obtaining of reasonable pressure drop through the bed. Due to the low velocity of the air flow through the bed during normal breathing operations very low pressure drops occur. Draft gauges installed to measure this factor during some of the tests have shown that the pressure drop across the bed never exceeds 0.05 in. w.g.

The low air velocity through the 20 inlet ports also obviated the necessity for installing a screen filter on the breathers. No operating difficulties were encountered during the period of the test due to the absence of screens.

Conclusions

The following conclusions may be summarized from the results to date:

(1) Neither complete reactivation nor exhaustion of the silica gel ever occurs, rather the silica gel in the breather tends to approach an equilibrium condition dependent upon both the ambient psychrometric conditions and the humidity prevailing inside the container. This equilibrium will never quite be attained because the dependent conditions are constantly changing.

(2) While the breather will maintain a satisfactory preservation level of humidity inside a tight, correctly engineered container, it is not a corrective device, that is, it will not remove appreciable quantities of water from a wet pack. The contents of the container must be properly predried so that the stored materials are in equilibrium with the desired humidity level and a sufficient amount of flywheel desiccant must be added; further, the container must be tight, since leaks permit moisture to enter without passing through the breather.

Acknowledgement is made to the Ordnance Department of the Army, under whose authority these tests were made.

AIR CONDITIONING RETAIL FOOD STORES

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Government statistics for 1946 show that there are approximately 474,000 food stores in the United States. In addition, there are approximately 29,800 general stores which also handle food. This makes a total in excess of 500,000 establishments handling food in the United States. Of this total, very few are air conditioned and many are not even ventilated or adequately heated. This article covers the necessary design calculations for air conditioning this type of retail store.

THE number of retail food stores on the Pacific Coast employing mechanical cooling for comfort is almost negligible. However, in the warmer dry regions of the Pacific area there are many stores using evaporative cooling, and one of the larger food chains has several hundred stores in California and Arizona equipped with evaporative coolers. In the more humid regions of the South and East, there is a greater predominance of mechanical cooling. However, on the whole, the field of air conditioning for retail food stores is relatively untouched.

Basis for Design

Air conditioning systems for retail food stores should be designed to perform the following major functions:

(1) Provide comfortable conditions for customers.
(2) Provide comfortable conditions for employees.
(3) Improve the keeping qualities of the food being sold, particularly fresh fruits and vegetables.

Incidental to these three major functions are a number of other benefits which will be derived from air conditioning. Some of the most important of these are listed:

(1) Use of clean filtered air to reduce the frequency of cleaning and painting store interiors.
(2) Proper ventilation in connection with air conditioning will reduce odors from occupants, fruits and vegetables, and from other store stock.
(3) Maintenance of a positive pressure inside the store, by having an excess of fresh outside air over exhaust air, will largely prevent the infiltration of dust and dirt from the outside.
(4) Lower temperatures inside the store will improve the operating conditions of air-cooled refrigeration units for meat cases, walk-in refrigerators, ice cream cabinets, and frozen food cases.

As against these advantages, we must balance the cost of the initial equipment and installation, and also the operating cost of the air conditioning equipment. It is almost axiomatic that air conditioning will increase sales at first. But it is questionable whether the increased sales volume will continue when the competitor across the street also puts in air conditioning. Then everyone is practically back on the same footing as before.

Air conditioning can only be economically justified if the volume of business and the profit margin continue high enough to absorb interest on the extra capital expenditure, depreciation and operating costs, and still leave a reasonable profit for the business. Therefore, in many cases, complete air conditioning cannot be justified. Some modified form of cooling and ventilating is all that the traffic will bear. However, mass production of packaged air conditioning units may in time reduce costs to a point where the capital expenditure will not be such a large item. Several large food chains have already tried the packaged air conditioners with considerable success.

Methods of Cooling

Summer cooling inside a store is usually provided by one of the following three methods:

(1) Ventilation with large quantities of outside air.
(2) Evaporative cooling using 100% outside air in somewhat smaller quantities in the usual wetted pad or spray type cooler.
(3) Mechanical cooling with refrigeration, using a smaller air circulation than either ventilation or evaporative cooling, and recirculating about 75% of the supply air. In certain localities where cool well water is available for precooling the fresh air, mechanical cooling can be economically used without recirculation.

The climatic conditions in the area where the store is located largely determine which type of cooling is the most feasible. (Refer to ACRMA Code of Application Engineering Standards for Air Conditioning for Comfort for recommended outside design conditions.) We can set up three climatic zones in the United States according to outside design temperatures, as follows:

(1) *Ventilation Zone* (low outside dry bulb temperatures): 85F and lower outside design dry bulb.
(2) *Evaporative Cooling Zone* (low outside wet bulb temperatures): 95 to 110F outside design dry bulb; 62 to 70F outside design wet bulb. (Preferably 25F or more difference between dry and wet bulb.)
(3) *Mechanical Cooling Zone* (high outside wet bulb temperatures): 90 to 110F outside design dry bulb; 70 to 80F outside design wet bulb.

There is a gap in the above zones between 86 and

89F design dry bulb temperatures where ventilation is not ordinarily satisfactory and it is hard to justify mechanical cooling. The common evaporative cooler will not do a good job because there is not sufficient wet bulb depression (difference between outside dry and wet bulb temperatures). A highly efficient air washer (a type of evaporative cooler), with two spray banks and capable of cooling 85% to 95% of the wet bulb depression, might be used with design wet bulbs below 70F. Supply air temperatures around 72F or lower, depending upon the wet bulb, would be possible. However, air washers are seldom used in retail food stores, except possibly for a large super market application. When in doubt, mechanical cooling is always the safest bet if the cost can be justified. And often the cost will not be much more than a fancy ventilation system or a complicated system designed to take full advantage of all evaporative cooling possibilities.

Methods of Heating

Some type of heating system is needed in winter for comfort of employees and customers, and to prevent freezing of food products during cold weather, especially at night. Where natural gas is available, direct-fired gas unit heaters provide the cheapest installation and the least operating costs. Where natural gas is not available, either oil- or coal-fired heating systems are generally the most economical. Steam unit heaters in connection with gas-, coal- or oil-fired boilers are the usual choice for steam heating systems for stores.

Entrance doors are always a problem because of drafts. Often this problem is solved by locating a unit heater near each entrance and blowing toward the entrance. An alternate solution is to locate a unit heater above each entrance with the warm air directed downward. Another heating solution for the check stand, aggravated because of its proximity to the entrance door, is the use of floor panel heat in these areas. In the case of a complete air conditioning system using air ducts, one main heating coil may be used, but some sort of booster heater should be provided for the entrances in cold climates.

Climatic zones for heating, similar to those given previously for cooling, may be arbitrarily set up as follows:

(1) *Mild Temperatures* (light heating load): 40 to 25F outside design dry bulb.
(2) *Cold Temperatures* (medium heating load): below 25 to 10F outside design dry bulb.
(3) *Severe Temperatures* (heavy heating load): below 10F outside design dry bulb.

Cooling by Ventilation

Ventilation is the least expensive method of providing a certain degree of comfort inside a store in climates where the outside temperatures are comparatively low during the cooling season. With ventilation alone, however, the inside temperature will be higher than the ambient temperature because the ventilation air entering at the outside temperature must absorb the heat load within the room and be raised in temperature accordingly. The amount of this temperature rise depends upon the internal heat load and the quantity of ventilation air introduced. The more air handled, the smaller the temperature rise, but there are limits to the amount of air movement that can be tolerated. About 50 fpm average air velocity through the occupied space would be maximum, and that would be somewhat drafty in spots as the velocity would not be uniform over the cross-sectional area. Usually the quantity of ventilation air is calculated on an air change basis of from 5 to 15 changes per hour in the conditioned space. This represents a range of from

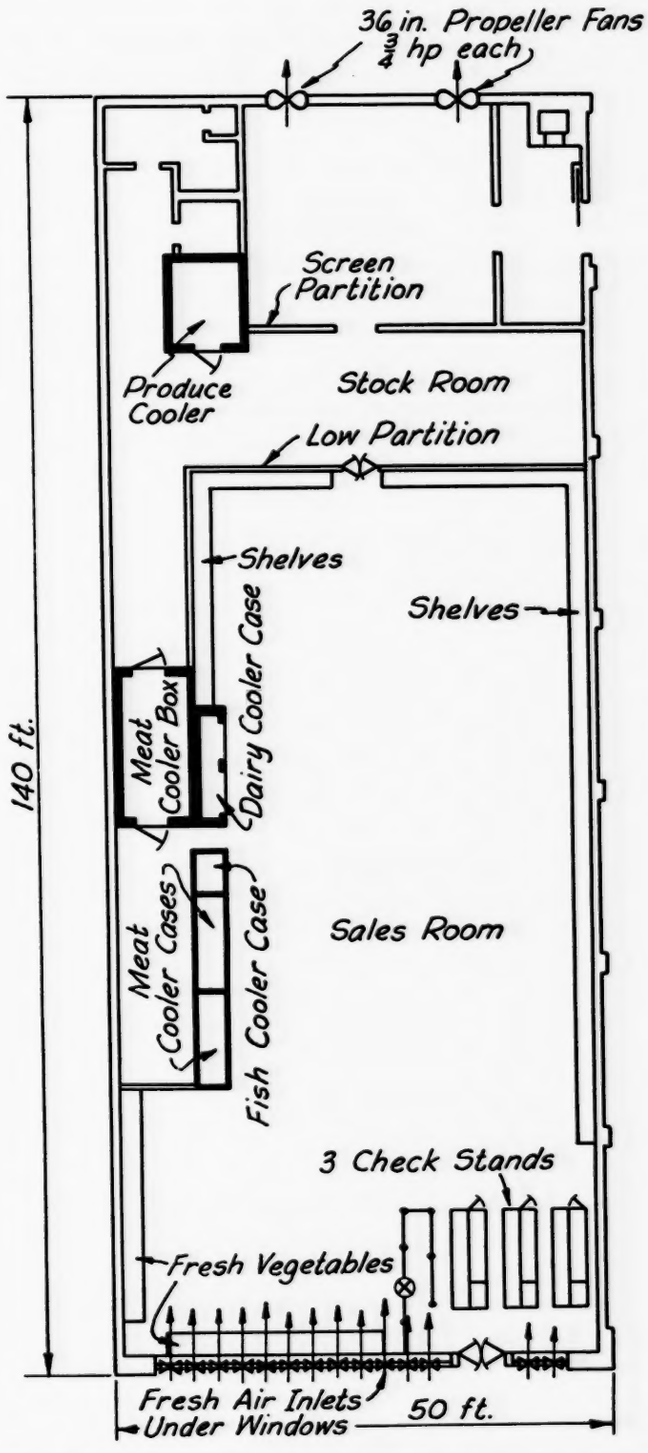


Fig. 1. Typical ventilation plan for a retail food store using exhaust fans.

4 to 12 minutes for a complete air change in the conditioned space.

A means of supplying the ventilation air, as well as a means of exhausting it, must be provided. Often propeller type exhaust fans are provided in the back wall of the stock room. Outside air is drawn through the store from gravity openings near the floor in the front wall and is discharged out through the rear wall by the exhaust fans. Another method is to provide gravity openings near the floor along the outside walls and relief grilles in the ceiling to the attic space. Attic exhaust fans are then used to induce ventilation air movement through the occupied space and into the attic. Either the attic exhaust or the back wall exhaust method will give a very inexpensive ventilation system. However, neither system provides a positive pressure inside the building to prevent infiltration of dust and dirt from the outside.

It is difficult to obtain uniform air distribution with exhaust fans alone. More satisfactory results will be obtained by providing a supply fan with distribution ducts and grilles, in conjunction with exhaust fans. However, the cost of a combination supply and exhaust system generally runs so high that it becomes feasible to consider the additional expense of using evaporative or mechanical cooling to obtain more comfortable summer conditions than can be had with ventilation alone.

Ventilation calculations for a typical 50 ft wide by 140 ft long food store (95 ft retail section, plus 45 ft stock room) with a 14 ft ceiling height, and in a climatic zone having a summer design dry bulb temperature of 85F or lower, would be as follows:

$50 \times 140 = 7{,}000$ sq ft floor area

7,000 sq ft $\times$ 14 ft ceiling height $=$ 98,000 cu ft volume

Use 2 propeller exhaust fans in rear 50×14 ft wall

$50 \times 14 = 700$ sq ft cross-sectional area of store

Figuring 50 fpm average velocity through the store over the cross-sectional area, we have:

$700 \times 50 = 35{,}000$ cfm maximum ventilation air

Consider ventilation at the rate of 5 minutes per air change, or 12 changes per hour, then:

$\frac{98{,}000}{5 \text{ Min.}} = 19{,}600$ cfm required.

For this store use two 10,000 cfm 36 in. diameter propeller type exhaust fans, each with a ¾ hp motor

Fig. 1 shows a typical arrangement of the exhaust ventilation system for this store.

Evaporative Cooling

Evaporative cooling is normally more expensive than straight ventilation, but less expensive than mechanical cooling. This applies to both initial installation and to operating costs. Since evaporative cooling systems cost much less to own and to operate than complete air conditioning systems with mechanical cooling, they have been used quite extensively in retail food stores located in hot dry climates. They give very satisfactory results in food stores, except during the few days during the summer when the outside wet bulb temperature is unusually high and the dry bulb temperature considerably below the peak design condition.

An evaporative cooler functions best with a large spread between the outside dry and wet bulb temperatures. When the outside conditions are "muggy," the inside conditions will be the same or worse, and occupants of the conditioned space will have a "clammy" or oppressive feeling with the evaporative coolers operating. Under such conditions it is best to shut off the evaporative coolers or to operate the fans alone with the water shut off. While mechanical cooling would eliminate these "muggy" periods, it is often very difficult to justify the considerable additional expense, both initial and operating, to take care of these short periods. During most of the cooling season, the wet bulb depression is comparatively large and evaporative cooling does a good job in hot dry climates. The factors of sales volume and store profit enter into the picture at this point and largely determine whether or not mechanical cooling is economically justified. With high prices and keen competition such as exists between food stores today, very few are in a position to increase food prices further to compensate for the increased cost of mechanical cooling.

On the other hand, evaporative cooling does have some advantages over mechanical cooling. With 100% outside air circulated, the air in the store will be fresher than when 75% of the air is recirculated, as is usually the case with mechanical cooling. Also, the moisture added to the air during cooling by evaporation improves the appearance and keeping qualities of fruits and vegetables on display.

Evaporative cooling calculations for a typical 50 ft $\times$ 140 ft store with 14 ft ceiling height, located in a climatic zone suitable for the use of evaporative cooling equipment are now considered. Table 1 summarizes inside and outside conditions and Table 2 shows the steps in the calculation of the sensible heat load. Other data are:

Floor area $= 50 \times 140 = 7{,}000$ sq ft

Room volume $= 7{,}000 \times 14 = 98{,}000$ cu ft

K factor = transmission factor, Btu per (hr) (sq ft) (F)

TABLE 1—CONDITIONS FOR EVAPORATIVE COOLING PROBLEM

Design Factor	Air Condition	
	Outside	Inside
Dry bulb temperature, F	100	85F
Wet bulb temperature, F	70	
Dew point temperature, F	54	
Relative humidity, %	20	
Grains per lb	62	
Btu per lb	33.4	
Cu ft per lb	14.3	

TABLE 2—CALCULATION OF SENSIBLE HEAT LOAD—EVAPORATIVE COOLING

Item	Calculation	Load in Btu per hr
Shaded front glass area	(75%) (50 × 14) = 525 sq ft	
Heat load*	(525) (1.13) (100 — 85)	8,900
Walls— glass area	(380 × 14) — 525 = 4,795 sq ft	
Heat load	(4,795) (0.33) (100 — 85)	23,700
Sun effect on 1 wall area	140 × 14 = 1,960 sq ft	
Heat load	(1,960) (0.33) (110 — 100)	6,470
Floor on ground	No Cooling Load	0
Ceiling to attic area (4 in. insulation)	50 × 140 = 7,000 sq ft	
Heat load	(7,000) (0.075) (115 — 85)	15,800
People	(100 persons) (180 Btu per hr each at 85F D.B.)	18,000
Lights	(14,000 watts) (3.41 Btu)	47,740
Air-cooled refrigeration compressors	(5 hp total connected load) (3,400 Btu)	17,000
Fan motors	(3 hp) (2.545 Btu)	7,635
Misc. electrical equipment	(1,500 watts) (3.41)	5,115
	Total sensible heat load	150,360

*In each case, formula for heat load is (area in sq ft) (K factor) (F temp. diff.)

Outside Design D.B. = 100F
Outside Design W.B. = 70F
Wet Bulb Depression = 30F

Evaporative coolers, depending upon design, will cool the entering air from 60% to 80% of the wet bulb depression, or with a wet bulb depression of 30F, this will be 18 to 24F.

Assume that 80% efficient coolers are used:

$0.80 \times 30 = 24$F cooling effect

With entering air at 100F, then 100 — 24 = 76F supply air. Then, allowable temperature rise in room = 85 — 76 = 9F

Btu per hr sensible heat load = (lb per min supply air) (60 min) (temp. rise) (sp ht)

$$\text{Lb per min supply air} = \frac{\text{cfm supply air}}{\text{cu ft per lb}}$$

$$\frac{\text{cfm supply air}}{\text{cu ft per lb}} = \frac{\text{Btu per hr sensible heat load}}{(60\text{ min})\ (\text{temp. rise})\ (\text{sp ht})}$$

$$\frac{\text{cfm supply air}}{14.3} = \frac{150{,}360\text{ Btu per hr}}{(60)\ (9)\ (0.24)}$$

$$\text{cfm supply air} = \frac{(14.3)\ (150{,}360)}{(60)\ (9)\ (0.24)} = 17{,}000$$

Therefore, use three 6,000 cfm 80% evaporative coolers which will provide 18,000 cfm total air circulation —all outside air.

Fig. 2 shows a typical arrangement of evaporative cooling equipment for a retail food store.

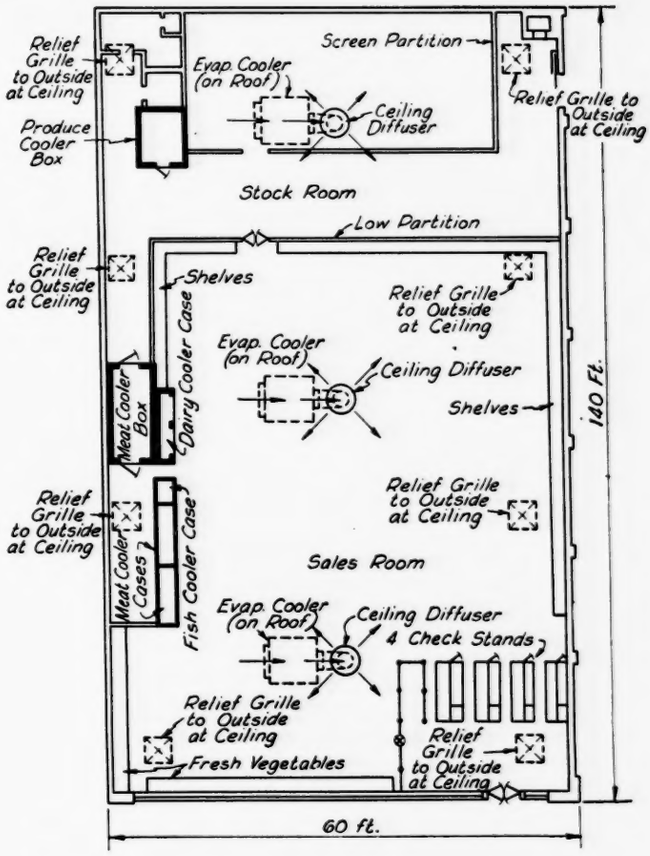


Fig. 2. Typical arrangement of evaporative cooling equipment for a retail food store.

$$\frac{98{,}000}{18{,}000} = 5.45 \text{ minutes per air change}$$

$$\frac{60}{5.45} = 11 \text{ air changes per hour}$$

If 60% evaporative coolers were used, then the cooling effect would be only (0.60) (30) = 18F. Air leaving the evaporative cooler would be 100 — 18 = 82F. Temperature rise in room = 85 — 82 = 3F.

$$\text{Supply air required} = \frac{(14.3)\ (150{,}360)}{(60)\ (3)\ (0.24)} = 49{,}800 \text{ cfm}$$

= less than 2 min air change in conditioned space.

This high air circulation would be quite drafty. See previous ventilation calculations. The room temperature should be allowed to rise to 86F so that the air supply could be reduced to 37,400 cfm with a 4F rise in the room.

To determine final room conditions, refer to psychrometric chart, Fig. 3.

Using 80% evaporative coolers and starting with air entering the evaporative cooler at 100F D.B. and 70F W.B., point A in Fig. 3, the air is cooled by evaporation along a constant 70F W.B. line through a 24F dry bulb range to 76F D.B., point B in Fig. 3. At this point the condition of the air entering the conditioned space is 76F D.B., 70F W.B., 67.5F D.P. and 74% R.H., as read from the psychrometric chart. Neglecting moisture gain in the room, this supply air will rise 9F D.B. along a constant 67.5F D.P. line to C while absorbing the sensible heat load in the room.

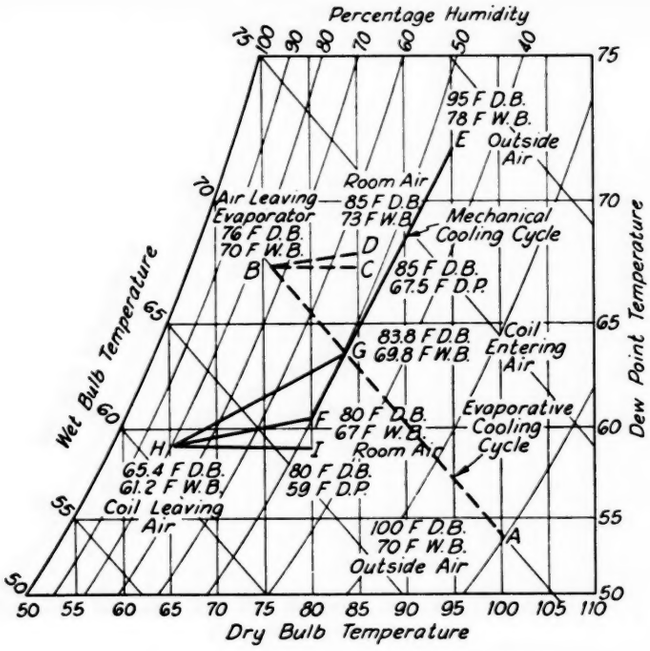


Fig. 3. Evaporative cooling and mechanical cooling cycles illustrated on psychrometric chart.

The internal latent load would be from the people in the room plus any moisture given off by the fruit and produce being displayed. Let us now calculate this latent heat load.

Latent Load	*Btu per hr*
(100 people) (220 Btu per hr ea. at 85F D.B.)	22,000
Assume 12,000 Btu per hr from fruit, produce and other moisture-generating sources	12,000
Total latent heat load	34,000

Room moisture gain in gr per lb =

$$\frac{\text{(Btu per hr latent load) (7,000 gr)}}{\text{(1,060 Btu per lb moisture) (lb air circulated per hr)}}$$

$$= \frac{\text{(34,000 Btu) (7,000) (14.3)}}{\text{(1,060) (18,000 cfm) (60 min)}} = 2.63 \text{ grains per lb}$$

Moisture content of supply air at 67.5F D.P.	= 101.0 gr per lb
+ Moisture gain in room	= 2.63 gr per lb
Final room moisture content	103.63 gr per lb

Since this final moisture content corresponds to 68F D.P., the final store conditions will be 85F D.B., 68F D.P., 73F W.B., 56% R.H., as indicated from point *D*, Fig. 3.

A well designed evaporative cooling system should provide air circulation of 2.5 to 5 cfm per sq ft of floor area. The cost of such an installation, depending upon elaborateness of the air distribution ductwork, will vary from 25 to 50c per sq ft of floor area. This is less than half the cost of a mechanical cooling job.

Mechanical Cooling

Mechanical cooling is the most positive and most universally satisfactory method of providing comfort conditions in summer. It employs refrigeration equipment, including compressor, condenser and an evaporator or cooling coil. Sometimes the evaporator is a water cooler for providing chilled water for circulating through surface cooling coils, or for spraying in an air washer, but more often direct expansion cooling coils are used. The refrigeration equipment reduces the temperature and humidity of the air supplied to the store. Such a system is commonly called air conditioning, which term technically includes cooling and dehumidifying in summer, heating and humidifying in winter, filtering and cleaning of the air, and proper air distribution by means of air ducts and grilles.

Mechanical cooling systems are more expensive in both initial cost and operating costs than either ventilation or evaporative cooling. Therefore, building insulation is an important consideration. For one-story buildings, 3 to 4 in. of roof or ceiling insulation is practically a minimum requirement.

Because of the high cost of equipment and operation, it is not economically feasible to circulate 100% outside air except in localities where cool well water can be pumped cheaply and used for precooling the

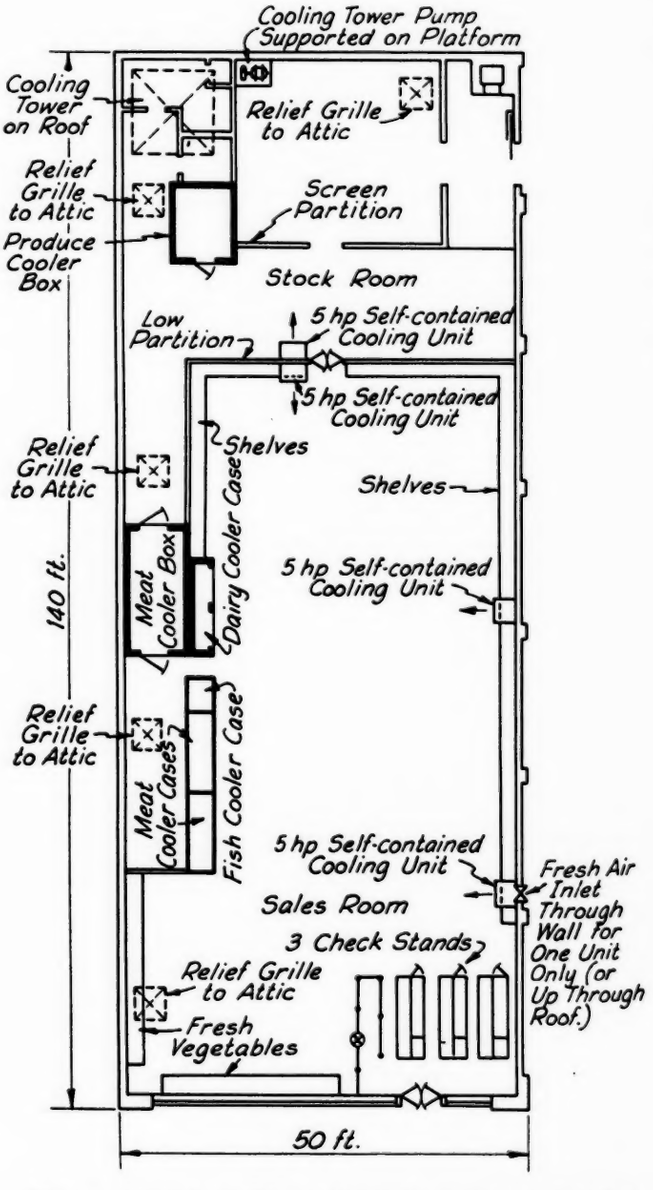


Fig. 4. Typical cooling equipment layout for a retail food store, using 5-hp packaged air conditioning units.

incoming air. About 25% of the air circulated is fresh outside air, the remaining 75% being recirculated air. However, dampers are usually provided so that all fresh air can be circulated with the return air shut off, when the weather outside is mild. Relief vents, usually to the attic, must be provided to let the excess air out when large quantities of fresh air are used. The attic space should have roof ventilators to the outside. On the heating cycle, where the outside winter temperatures are very severe, the fresh and return air mixing dampers may be set to take a minimum of 10% outside air and 90% return air during the coldest weather to save fuel.

Mechanical cooling calculations for the same typical 50 ft x 140 ft store used as an example previously, but this time located in a climatic zone where mechanical cooling is necessary for comfort, would be as follows, with Table 3 listing the outside and inside air conditions, and Table 4 the steps in calculating the heat load.

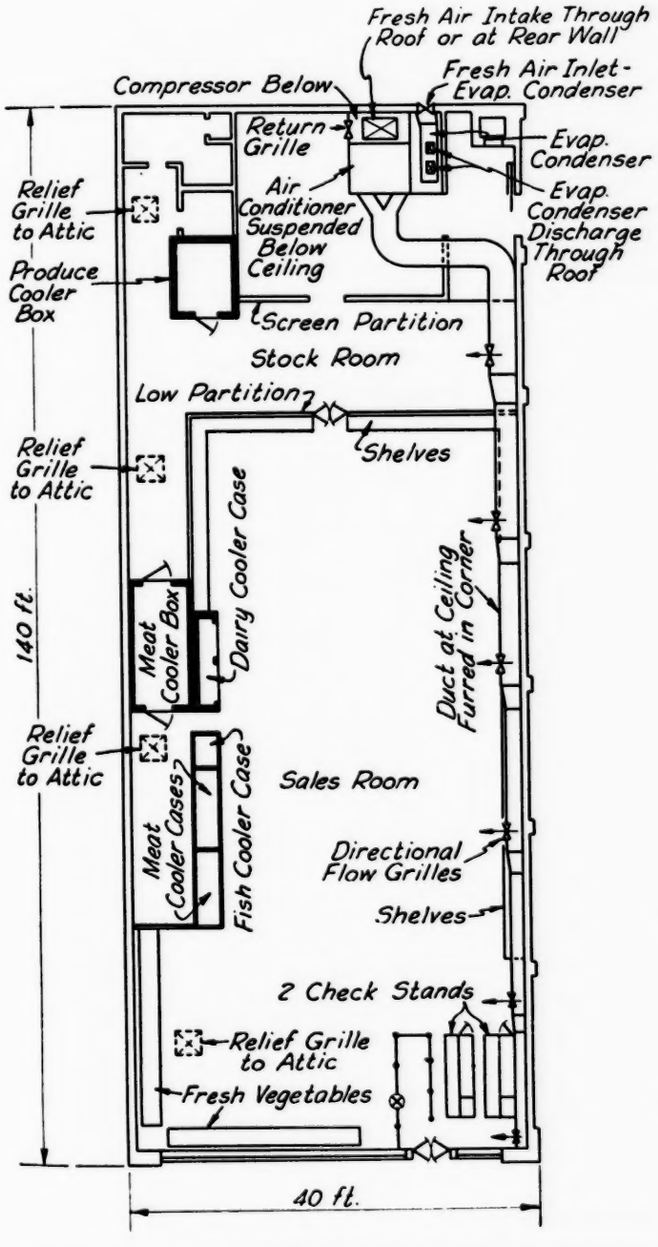


Fig. 5. Typical cooling equipment layout using central unit and sidewall air distribution.

Floor area = 50 × 140 = 7,000 sq ft
Room volume = 7,000 × 14 = 98,000 cu ft
K factor = transmission factor, Btu per (hr) (sq ft) (F)

TABLE 3—CONDITIONS FOR MECHANICAL COOLING PROBLEM

Design Factor	Air Condition	
	Outside	Inside
Dry bulb temperature, F	100	80
Wet bulb temperature, F	75	67
Dew point temperature, F	64.5	60
Relative humidity, %	30	50
Grains per lb	91	77
Btu per lb	37.7	31.1
Cu ft per lb	14.35	13.85

TABLE 4—CALCULATION OF HEAT LOAD—MECHANICAL SYSTEM

Item	Calculation	Btu per hr
	Sensible Heat Load	
Shaded front glass area	(75%) (50 × 14) = 525 sq ft	
Heat Load*	(525) (1.13) (100 — 80)	11,900
Walls—glass area	(380 × 14) — 525 = 4,795 sq ft	
Heat Load	(4,795) (0.33) (100 — 80)	31,600
Sun effect on 1 wall area	140 × 14 = 1,960 sq ft	
Heat Load	(1,960) (0.33) (110 — 100)	6,470
Floor on ground	No cooling load	0
Ceiling to attic (4 in. Insulation)	50 × 140 = 7,000 sq ft	
Heat Load	(7,000) (0.075) (115 — 80)	18,400
People	(100 persons) (220 Btu per hr each at 80F D.B.)	22,000
Lights	(14,000 watts) (3.41 Btu)	47,740
Air cooled ref. compressor in store	(5 hp total connected load) (3,400 Btu)	17,000
Fan motors	(5 hp) (2,545 Btu)	12,725
Misc. electrical equip.	(1,500 watts) (3.41 Btu)	5,115
	Total internal sensible heat load	172,950
	Latent Heat Load	
People	(100 persons) (180 Btu per hr each at 80F D.B.)	18,000
Miscellaneous moisture generating sources, including fruits and vegetables; estimated		12,000
	Total internal latent heat load	30,000

*In each case, formula for heat load is (area in sq ft) (*K* factor) (F temperature diff.)

The minimum fresh air quantity should be sufficient to give a complete air change in the conditioned space in one hour:

$$\frac{98{,}000}{60} = 1{,}633 \text{ cfm minimum outside air}$$

The total air circulation should be at least four times

TABLE 5—DESIGN DATA FOR THREE WARM CLIMATE STORES

	Little Rock, Ark.	Waco, Texas	Modesto, Calif.
Floor area—sq ft	7,366	6,600	21,000
Room volume—cu ft	103,124	92,400	336,000
Outside design D.B. (summer), F	95	100	100
Outside design W.B. (summer), F	78	78	72
Outside design D.B. (winter), F	5	10	30
Inside design D.B. (summer), F	80	80	80
Inside design R.H. (summer), %	50	50	50
Inside design D.B. (winter), F	65	65	70
Supply air—cfm	8,400	8,400	22,000
Outside air—cfm	2,100	2,800	5,500
Sensible cooling load—tons refrig.	13.3	15.6	53.4
Latent cooling load—tons refrig.	5.8	5.9	11.6
Total cooling load—tons refrig.	19.1	21.5	65.0
Heating load—Btu per hr	294,650	250,000	500,000
Freon-12 compressor, hp	15	20	60
D.E. cooling coil; face area, sq ft	16	16	44
D.E. cooling coil; rows deep	4	4	6
Entering air to cooling coil—D.B., F	83.8	86.7	85.0
Entering air to cooling coil—W.B., F	69.8	70.8	68.3
Leaving air from D.E. coils—D.B., F	65.4	65.2	57.0
Leaving air from D.E. coils—W.B., F	61.2	61.2	56.4
Evaporator temperature, F	50	42.5	45
Fan motor, hp	5	5	10
Evap. condenser—tons refrig.	19.1	21.5	65*
Evaporator condenser fan, cfm	6,000	7,500	18,000*
Evaporator condenser fan, hp	1½	2	6*
Evaporator condenser pump, hp	½	½	1*
Condensing temperature, F	105	105	98

*For two units.

the amount of fresh air, or (4) (1633) = 6,533 cfm. This amounts to a 15 min air change or 4 changes per hour. A somewhat greater air circulation would be preferable, so figure 5 changes per hour, or a 12 min air change.

$$\frac{98{,}000}{12} = 8{,}167 \text{ cfm total supply air}$$

(8,167) (0.25) = 2,042 cfm fresh air

Sensible heat load from fresh air, Btu per hr = (lb air per min) (sp ht) (temp rise) (60 min)

(2,042/14.35) (0.24) (100 — 80) (60) = 41,000 Btu per hr

Latent heat load from fresh air, Btu per hr = (lb air per min) × (moisture pickup from fresh air, gr)

$$\times \frac{\text{(1,060 Btu per lb moisture)}}{7{,}000} \times \text{(60 min)}$$

Latent heat load from fresh air, Btu per hr =

$$\frac{\text{(2,042 cfm) (91 — 77) (1,060) (60)}}{\text{(14.35) (7,000)}} = 18{,}100$$

(1) Therefore, total sensible heat load = internal load + fresh air load = 172,950 + 41,000 = 213,950

(2) Therefore, total latent heat load = internal load + fresh air load = 30,000 + 18,100 = 48,100

Total cooling load (1) and (2) = 262,050

$$\text{Tons refrigeration} = \frac{262{,}050}{12{,}000} = 21.9$$

Normally this store would be equipped with a 20 hp Freon-12 refrigeration compressor; cooling coils, fan and ductwork for 8,167 cfm; evaporative condenser for 22 tons refrigeration at 75F outside wet bulb; and necessary piping, controls, refrigerant, etc. A water-cooled condenser, with cooling tower and condenser water circulating pump, could be substituted for the evaporative condenser. As an alternate, four 5 hp packaged type air conditioners could be used. Cooling equipment is normally selected from manufacturers' catalogs, with the high side (compressor and condenser) properly balanced against the low side (evaporator or cooling coils) in accordance with the calculated sensible and latent heat loads and the design conditions. Fig. 4, 5 and 6 show three typical arrangement plans for air conditioning a store of this type.

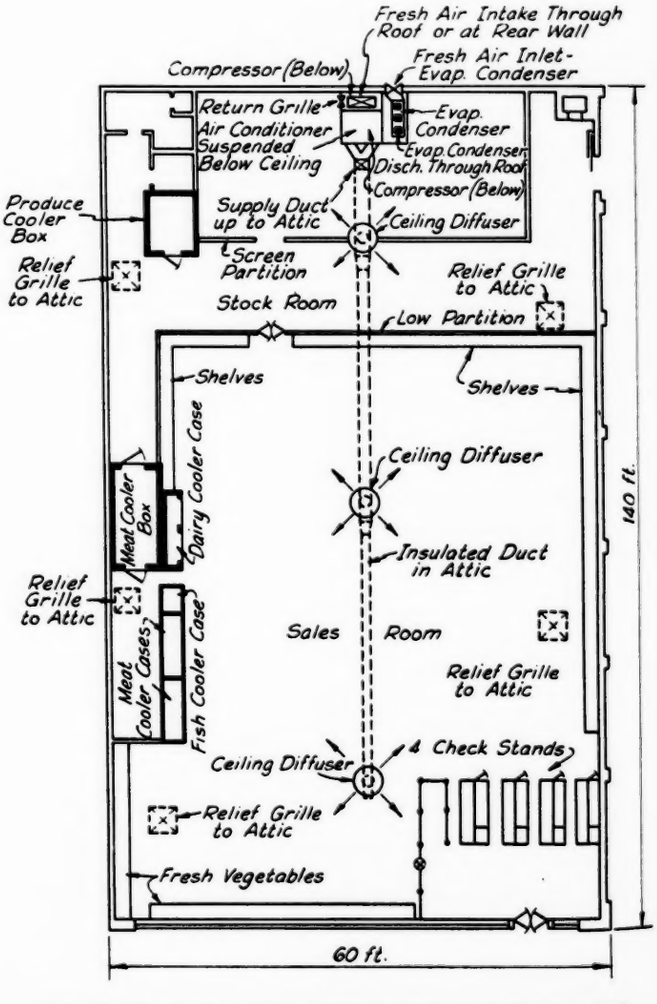


Fig. 6. Typical cooling equipment layout for a retail food store using central unit and an attic supply duct.

Table 5 gives cooling loads and equipment selections for several retail food store air conditioning systems in various typical warm climates where air conditioning is desirable.

The cooling cycle for a mechanical system can be illustrated on the psychrometric chart, Fig. 3, to compare with the evaporative cooling cycle described previously. Taking the Little Rock, Ark., store in Table 5 as an example, we have *E* at 95F D.B. and 78F W.B. as the outside condition, and *F* at 80F D.B. and 50% R.H. (67F W.B.) as the inside condition. The entering air to the cooling coils will fall on the straight line joining *E* and *F*. With 8,400 cfm supply air, of which ¼ or 2,100 cfm is outside air and ¾ or 6,300 cfm is return air, the entering air condition will fall at point *G*, which is ¼ the distance from *F* to *E*, and closer to *F* the room condition than to *E* the outside condition. Point *G* can be calculated or graphically determined as 83.8F D.B. and 69.8F W.B. In passing through the cooling coils, the 8,400 cfm supply air will be cooled along the line *FH* to the leaving air condition of 65.4F D.B. and 61.2F W.B. The supply air, after leaving the cooling unit will rise in temperature to absorb the heat load in the room. If there were no latent load, the air would rise along a constant 59F D.P. line *HI* to 80F D.B., at *I*, in absorbing the 13.3 tons sensible heat load. As there is a latent heat load of 5.8 tons, the supply air will rise along the line *HF* in absorbing the total load of 19.1 tons, to the final room condition of 80F D.B. and 50% R.H. (67F W.B.) at *F*.

With mechanical cooling systems, as usually designed for store air conditioning, one horsepower in the refrigeration compressor will produce one ton of refrigeration effect, or perhaps slightly more. The requirement for air conditioning of retail food stores is about one horsepower, or one ton refrigeration, for each 300 to 500 sq ft of floor area, depending upon climatic conditions. The air circulation should be from 1 to 1.25 cfm per sq ft of floor area. A fan cooling system with refrigeration, or a system employing a multiple of small (3 or 5 hp) unit air conditioners, generally costs from $1 to $1.50 per sq ft of floor area, or from $400 to $600 per ton refrigeration, with $500 per ton as a good average figure.

TABLE 6—CONDITION FOR HEATING PROBLEM

Design Factor	Air Condition	
	Outside	Inside
Dry bulb temperature, F	5	65
Cu ft per lb	11.8	13.5

Courtesy, Marlo Coil Co.

Fig. 7. Air conditioned Battendorf's Hampton Village Market, St. Louis, Mo., shows how extensive food markets have become.

Courtesy, Marlo Coil Co.

Fig. 8. Inside Battendorf's Hampton Village Market. Unit suspended over the meat department is a 15-ton remote type air conditioner using chilled water from a central cooling system. A similar unit is suspended directly over the produce department.

Heating

Heating calculations follow in general the methods outlined in the ASHVE *Guide*, with the exception that the inside design temperature is usually taken as 65F D.B. instead of 70F. This is for the reason that the customers are in street clothes and are moving about. Therefore they do not normally require as high as 70F inside temperature, in fact they might be uncomfortably warm at this temperature. However, the employees, particularly at the check stands, are not so warmly dressed and would be more comfortable at 70F. It is, therefore, advisable in the colder climates to have booster heaters at the entrances to offset drafts, and perhaps floor panel heaters at the checking stations to make them more comfortable for the employees. Humidification is not a problem in retail food stores in winter except in unusual circumstances. Therefore, auxiliary humidification is almost never provided for this store heating application.

Heating calculations for the same typical 50 ft x 140 ft store used in the cooling calculations would be as follows, with air conditions listed in Table 6 and heating calculations given in Table 7.

Minimum outside air = 1 air change per hr = $\frac{98{,}000}{60}$ = 1,633 cfm

Increase outside air by amount of air blown out by exhaust system, say in this case, 467 cfm additional to provide 2,100 cfm total outside air.

Heating requirements are quite variable, depending upon climatic conditions, but heating loads, including fresh air, usually run from 25 to 50 Btu per hr per sq ft of floor area. Heating costs also depend upon the type of heating system and the climatic zone, but may be anywhere from 5 to 50¢ per sq ft of floor area. Direct-fired gas heaters are the cheapest and can generally be installed for 5 to 15¢ per sq ft of floor area for an average sized store of around 7,000 sq ft. This contemplates the use of 1 or 2 unit heaters, or duct-type gas furnaces in connection with the air conditioning system. If an oil-fired air heating furnace with a small amount of distribution ductwork is indicated by fuel costs and climatic conditions, the cost will run in the neighborhood of 20 to 40¢ per sq ft of floor area. A steam-unit heater system with steam boiler, using coal stoker or oil burner, generally costs between 35 to 50¢ per sq ft of floor area.

TABLE 7—CALCULATIONS FOR HEATING LOAD

Item	Calculations	Btu per hr
Front glass area	(75%) (50 × 14) = 525 sq ft	
Heat load*	(525 sq ft) (1.13) (65 — 5)	35,600
Walls— glass area	(380 × 14) — 525 = 4,795 sq ft	
Heat Load	(4,795) (0.33) (65 — 5)	94,900
Floor on ground area	50 × 140 = 7,000 sq ft	
Heat Load	(7,000) (0.10) (5)	3,500
Ceiling to attic (4 in. Insulation)	7,000 sq ft	
Heat Load	(7,000) (0.075) (65 — 15)	26,250
	Sub Total	160,250
Fresh air load	$\frac{(2100)(0.24)(65 - 5)(60 \text{ min})}{13.5 \text{ cu ft per lb}}$	134,250
	Total Heating Load	294,500

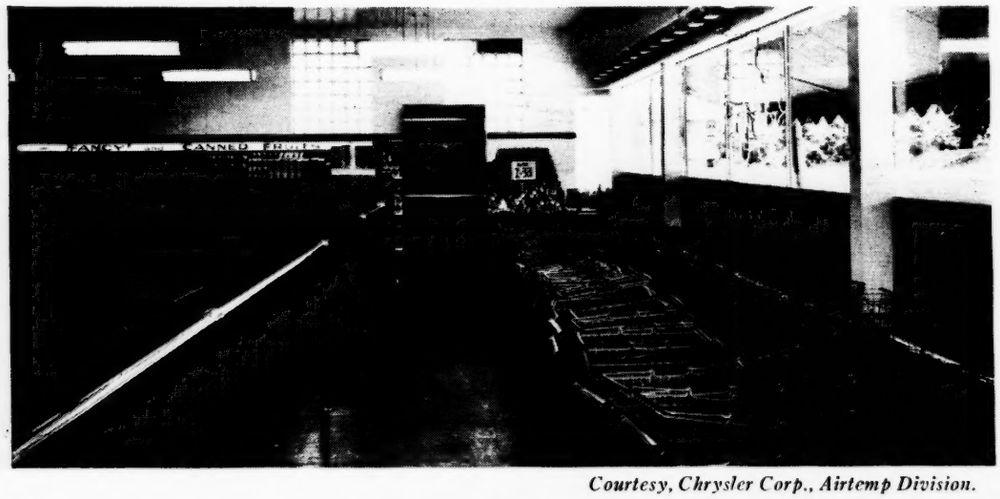
*In each case, heat load = (area in sq ft) (*K* factor) (F temp. diff.)

Conclusion

Practically all retail food stores in the United States should have some type of heating for winter. The matter of cooling in summer depends more upon location and climatic conditions. In the cooler climatic zones, ventilation with outside air is often sufficient for satisfactory conditions and the cost of ventilation fans can be quite nominal. In hot dry climates, evaporative cooling systems can be used to advantage and at a cost, on the average, of less than half of a mechanical cooling system. The ultimate in comfort conditions is only obtained by the use of mechanical refrigeration. Such systems are absolutely necessary in hot humid climates if comfortable conditions are to be maintained throughout the summer. However, mechanical cooling systems are the most expensive and a good average figure is $500 per ton refrigeration capacity, or $1.25 per sq ft floor area. In addition, the operating and maintenance costs are high. Based on a cooling season of 1,000 hours operating time and power at 1.5¢ per kwh, a rough average figure is $30 per ton refrigeration per season, not including interest and depreciation on the capital investment.

Heating equipment costs vary over a wide margin, depending upon the fuel available and the climatic conditions. A simple direct-fired gas unit heater installation in a mild climate may only run about 5¢ per sq ft of floor area. A steam unit heater system with steam boiler controls and piping for a fairly severe climate may run as high as 50¢ per sq ft of floor area. Radiant or panel heating has possibilities for retail food store applications, but so far has been little used. The cost would be in the same neighborhood as the more expensive steam heating systems. Operating costs for the heating cycle vary so greatly with climatic conditions and fuel costs that it is practically impossible to set an average figure.

A wide field is open for heating, ventilating and cooling in the retail food store business. The further development of packaged air conditioning equipment may reduce costs sufficiently so that most of the 500,000 retail food stores will be prospective customers for complete air conditioning. In the meantime the field is relatively untouched and full of opportunities for the application of new equipment and methods that will provide low cost air conditioning for the very competitive and low profit margin retail food store business.



Courtesy, Chrysler Corp., Airtemp Division.

Fig. 9. Interior of a Kroger store showing a 5-hp self-contained air conditioning unit for the check stand area.

Experience is my Classroom

By T. W. REYNOLDS

• HEATING SYSTEM GOES TO BLAZES

When a man bites a dog, thats news, but when the vent on a hot water heating system spouts a flame, that's big news.

A Long Island contractor recently opened the vent on a forced hot water heating system in a residence, only to have the discharge from this vent ignite from a lighted match held in his hand. Noises at the circulator had seemed to indicate an air-bound system, hence the contractor had lit the match, the better to find an air vent.

Speculation as to causes included the idea of gases generated from dope on pipe threads, plus oil from pipe and valves. Another thought was that a mild winter with early spring might hasten the annual turnover of surface water in reservoirs. When maximum density is reached at 39.2F the waters equalize in temperature, so as to bring up the decomposed vegetation.

Of course, the real answer was oxygen liberated from the water, together with other combustible gases. Venting of this mixture, dissolved in the water, soon brings relief, provided no new water is added. Unfortunately, renewal of the water in this case aggravated the situation and gave only temporary relief.

Flaming water, so-appearing, though seldom heard of, is not a new thing in systems which, being closed, can accumulate gases.

• TIMES HAVE CHANGED

One block away and down 20 stories from my office is the excavation where not so long since the old Murray Hill Hotel imposed its weight since 1884, and where shortly a 36-story office building will arise. Observing the work going on, one is impressed by the few workers and the many machines. That Diesel engine shovel snorting around, the bulldozer playing tag close behind it, and the pneumatic rotary drill are all labor-saving devices, yet if we could bring back the workers who built the former building by hand, we could do the job a lot cheaper. One also wonders whether it cost more to tear down the old building than it did to erect it.

Over in the conference room of Vermilya Brown, successors to Marc Eidlitz, who built the Murray Hill Hotel, there is a sign under glass reading as follows:

"On and after May 2nd, 1885, the wages of bricklayers in our employ will be 42 cents per hour. The number of hours worked per day will be 9, except Saturday, 8 hrs. work and 8 hrs. pay.

Marc Eidlitz & Son"

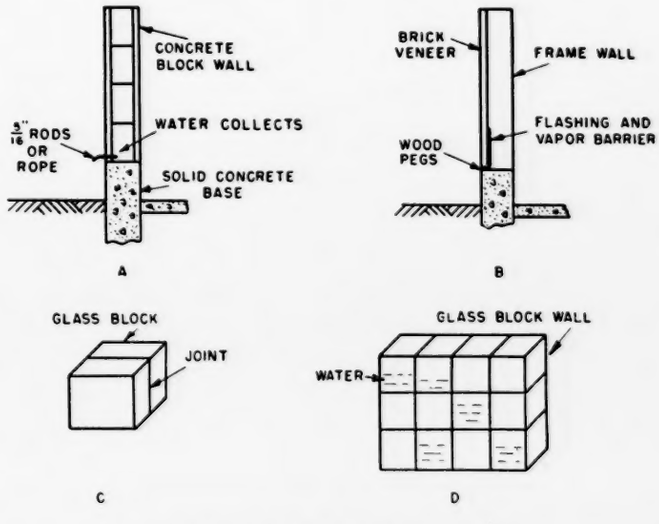
Just like that, and asking no one's permission. Presently, bricklayers are paid $3.20 per hr for some less brick laid in the same time.

When it comes to any discussion of the brick laid per hour, then and now, one can, if he wishes, make a very poor showing for the present day bricklayer, but a most unfair one. To render justice, one may point out that the brick walls of the old hotel when exposed in wrecking was a full 6 ft thick in many places. The outer courses were more carefully cemented in the usual way, but the interior of those walls contained brick merely laid dry and then quickly slushed over on their surface with mortar to give a bond to hold up the wall.

Today, brick is used for appearance and much less of it can be laid in a given time, since it is usually laid in only a 4-inch external course. Such brick is backed up by various masonry materials of lightweight to lessen the load on the footings.

• MOISTURE IN WALLS AFFECTS THE HEAT COEFFICIENT

One wonders what would happen to our heat coefficients if, in the laboratory, the wall specimens were filled with water, yet such are often the conditions in actual installation. A concrete block wall may collect rain-water, especially with an East (in the Northeast part of the U. S.) rain which is usually driving and of some duration. Rain enters through hair-line cracks of mortar joints. Waterproof paint at the joints may prevent this, but rain can still enter



Some walls that collected moisture.

Note: Mr. Reynolds is Chief, Air Conditioning Division, Abbott, Merkt & Co., Engineers, New York.

at any crack due to settlement of walls or other causes. Cinder block is worse, for it will absorb moisture.

The writer was speculating on all this as he watched the wasps coming and going through the drainage holes left by rod removal at the bottom blocks of a concrete block wall as shown at *A* of the accompanying sketch. Upon occasion, such holes plug up and when they are drilled out, the pent-up water is released. With drainage complete, the block once again provides excellent homes for the insect with the hot feet. In other walls, such as *B*, outlets for moisture are provided by the removal of wooden pegs.

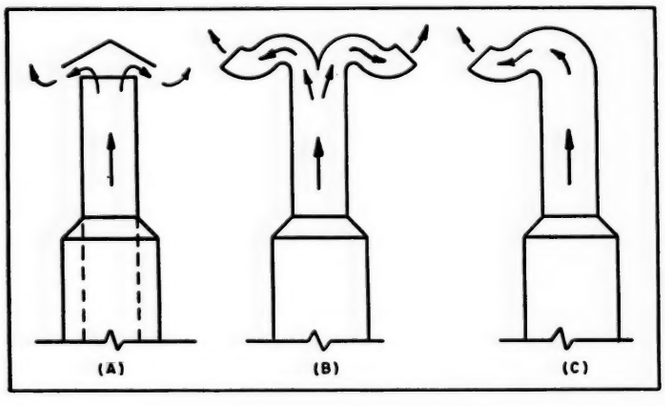
With the early types of glass block walls, there were occasional troubles due to rain entering at the joint as shown at *C*, so that the blocks were finally drilled for drainage. The writer knows of one building where one man is kept fairly busy removing the corks in many of the glass blocks as they fill with water. The water shows at various levels by refraction from the sun (see *D*). As the cork is temporarily removed, the water is received in a pail, otherwise it would stain the wall.

• CHIMNEY CAPS AS A HANDICAP

When a chimney has insufficient draft someone will probably add a 10 ft sheet metal extension, which is good, and then turn around and crown it with a vent cap (see *A*), which is bad. Any gain is then lost, and in fact the net result is one of much less draft, due to the two right-angle turns the gases must now take.

The hot gases have momentum and want to go straight up. On quiet days and with chimneys protected from winds and down-drafts, one may find a draft head of ten or more feet greater than their actual physical height. Those who install vent caps seldom take this into account, nor do they visualize the turns the gases must now take. These may be as shown in sketch *B*, or if there is a good wind, as in *C*.

All a vent cap is for is to protect the chimney from snow and rain, which, however, are quickly evaporated from a hot chimney, or absorbed by the bricks of a cold chimney. If the vent cap is extended to cover two or three adjacent flues, some one flue will act as a check on the others. The metal extension should not reduce the chimney diameter and the cap should be above the chimney by a distance equal to this diameter. The best thing that can happen is that the vent cap will soon rust out.



Chimney caps as a handicap.

• THE RE-USE OF TOILET AIR

During the last war the writer, as consultant to the War Production Board, restricted the recirculation of air from toilets, locker rooms, and kitchens to cases using activated carbon filtration, or else allowed it to be exhausted high up in adjacent industrial areas where it was diluted in the vastness of space, or masked by industrial odors.

This method was no worse than having unventilated toilets in industrial areas with partitions, but without roof. There were no laws requiring such open toilet spaces to be ventilated, but put a roof over one and there were definite laws, while everyone was horrified at the thought of discharging fan air from such places anywhere but outdoors.

In the light of this retrospection, it is interesting to observe that now, and for the last two years, it is permissible in New York City either to recirculate air from the places in mind, or discharge it to other occupied spaces, when the recirculated or discharged air is filtrated through activated carbon and so long as minimum ventilation is maintained as elsewhere provided in the city code for many years past. Similar approval is also granted by the U. S. Public Health Service for Land, Air and Sea Carriers. One other stipulation is that the filtration shall be properly maintained and operated.

• CHECK VALVES

Check valves in some form or other have been used for ages, and there are some places where they are required, but there are more places where they are neither required or desired, yet are often used. Recently, the interiors of two check valves on the returns to two boilers were removed, after which water levels in the boilers became fairly equalized.

Check valves on returns impose a resistance to a degree dependent upon the type used and the water must build up back of them to a height sufficient to lift their flaps. They seldom lift in unison and whichever lifts at one moment passes all the water. A check valve may serve to prevent the water from backing up out of an active boiler to flood a boiler at lower pressure, due to inactivity of the latter, but it does not prevent a high level in either boiler, and once a high level is built up in one boiler, it cannot back up and equalize with the other boiler, because of the check valve.

No matter how good the equalization lines may be on the steam side, the returns cannot equalize where there are check valves. Equalization by piping, even when direct, straight and sizable, can never be as good as desired, hence boilers should be equalized on both steam and return lines, both on top of the water and back of that water.

Even cast-iron boilers with large nipple ports do not always have the same water line from section to section, yet the sections have ports both at top and bottom. This shows the importance of equalization on both steam and water sides of boilers.

Bind in

HEAT LOSS FROM WATER SURFACE IN TANKS

Heat loss from the exposed liquid surface of an open tank is by convection and radiation from the surface and by evaporation of the liquid. The last especially is a rather involved phenomenon to measure, and the formula for the sum of these three different phases of heat loss is formidable.

The accompanying table is a solution of the formula for the common case of water where the relative humidity of the surrounding air is 70%, and for various water temperatures, air temperatures, and air velocities. The values in the table are based on a comprehensive treatment of the whole subject of heat losses from tanks and vats by Samuel J. Friedman, E. I. duPont de Nemours & Co. Note that air velocities are in feet per *second.*

Example. A 4 ft wide × 12 ft long dye vat maintained at 200F is located in a room where the average air temperature is 80F, and the air velocity is estimated at 0.5 ft per second. What is the heat lost from the water surface if the relative humidity of the air is 70%?

Solution. Referring to the accompanying table in the section devoted to 80F air find, opposite 200F and under 0.5 velocity, a heat loss of 4900 Btu per (sq ft) (hour). Since the tank has a water surface area of 4 × 12, or 48 sq ft, the total heat loss is 48 × 4900 = 235,200 Btu per hour.

Heat Loss from Water Surface at Various Air and Water Temperatures and Air Velocities

(When Relative Humidity Is 70%)

Water Temp., F	Air Velocity, Feet per Second							
	0	0.5	1	2	5	10	20	50
	Heat Loss, Btu per (hour) (Square Foot)							
	Air Temperature 100F							
100	35	70	82	105	130	200	330	700
110	105	170	200	250	315	480	800	1600
120	200	295	350	420	550	810	1380	2750
130	325	460	520	650	820	1250	2050	4200
140	500	670	800	950	1230	1800	3000	6200
150	730	930	1100	1300	1700	2600	4300	8700
160	1000	1290	1500	1800	2400	3600	5900	12,100
170	1380	1750	2050	2450	3300	4950	8200	17,000
180	1830	2450	2800	3300	4600	7000	11,500	24,000
190	2400	3500	4050	4800	6600	10,000	16,500	34,000
200	3100	5100	6000	7300	9400	14,300	24,000	48,000
	Air Temperature 80F							
80	17	34	40	49	66	106	185	330
100	58	96	113	135	185	280	460	920
110	210	285	320	380	540	780	1250	2550
120	315	420	470	560	760	1150	1850	3800
130	460	580	660	780	1090	1620	2600	5200
140	640	780	900	1060	1480	2200	3600	7200
150	860	1020	1200	1420	1970	2950	4800	9700
160	1150	1330	1590	1900	2550	3800	6300	13,000
170	1500	1730	2050	2500	3400	5200	8500	17,300
180	2000	2400	2750	3400	4700	7100	12,000	24,000
190	2550	3400	3900	4800	6600	10,000	17,000	34,000
200	3300	4900	5500	6900	9500	14,000	24,000	50,000

Water Temp., F	Air Velocity, Feet per Second							
	0	0.5	1	2	5	10	20	50
	Heat Loss, Btu per (Hour) (Square Foot)							
	Air Temperature 60F							
60	7	18	21	26	34	56	95	180
70	33	52	60	78	105	170	270	580
80	78	110	125	150	210	315	510	1050
90	130	180	210	240	330	490	780	1600
100	205	270	320	350	480	710	1150	2300
110	290	370	420	480	670	1000	1600	3300
120	400	500	570	660	930	1350	2200	4400
130	550	780	750	890	1240	1800	3000	6000
140	710	870	970	1150	1600	2400	4000	8000
150	950	1130	1260	1510	2100	3200	5300	10,500
160	1230	1450	1600	2000	2700	4050	6900	13,700
170	1600	1900	2100	2600	3700	5200	9100	18,500
180	2050	2600	2900	3550	5000	7200	12,500	25,000
190	2600	3550	4000	4950	6900	10,300	17,500	35,000
200	3300	5200	5700	7000	9700	14,600	25,000	50,000
	Air Temperature 40F							
40	3	8	10	13	17	26	46	85
50	25	36	42	47	60	100	160	320
60	58	75	86	94	130	190	310	620
70	90	115	130	150	210	300	490	970
80	135	170	195	225	310	450	720	1460
90	190	230	265	310	440	640	1030	2100
100	260	315	360	420	600	860	1400	2800
110	350	420	470	550	790	1130	1880	3700
120	460	550	610	720	1020	1500	2500	5000
130	600	700	770	930	1300	1950	3150	6400
140	800	880	970	1200	1760	2500	4200	8300
150	1020	1130	1430	1530	2150	3200	5300	10,600
160	1300	1450	1570	2000	2800	4200	7000	14,000
170	1700	1900	2100	2600	3700	5500	9400	18,800
180	2200	2550	2750	3500	4900	7400	12,500	25,000
190	2750	3400	3750	4700	6800	10,300	17,000	34,000
200	3400	4800	5500	6700	9700	15,000	25,000	50,000
	Air Temperature 0F							
40	77	93	102	113	155	235	360	700
50	105	121	134	153	215	315	490	940
60	135	155	170	195	270	410	630	1210
70	175	200	225	255	360	520	840	1610
80	225	255	280	320	450	680	1080	2100
90	285	320	350	410	580	860	1400	2700
100	360	400	440	510	720	1100	1760	3450
110	450	500	540	630	920	1350	2200	4400
120	560	610	680	800	1150	1700	2800	5600
130	700	750	840	1000	1440	2150	3550	7000
140	890	930	1030	1240	1800	2700	4450	9000
150	1100	1160	1300	1560	2250	3450	5700	11,300
160	1400	1460	1600	2000	2800	4400	7300	14,600
170	1800	1900	2100	2600	4700	5800	9700	19,400
180	2200	2500	2750	3400	5000	7700	13,000	26,000
190	2800	3400	3800	4700	7700	10,300	17,500	35,100
200	3500	4700	5300	6600	9800	15,000	25,000	50,000

Engineering Courses Available in Air Conditioning, Refrigeration, Heating and Ventilating

(Concluded from the March issue)

Location	School	Course	Term Offered	Credit Hours	Prerequisites	Comments
Minnesota						
Minneapolis (Continued)	University of Minnesota	Advanced Refrigeration		3Q	Refrigeration	Elective
		Refrig. Design		2Q	Refrigeration	Elective
		Refrig. Laboratory		2Q	Refrigeration	Elective
		Advanced Refrigeration		Credits arranged	Refrigeration	Graduate course
Missouri						
Columbia	University of Missouri	Heating and A.C.	1	3		Senior elective
		Heat. and A.C. Design	2	3		Senior elective
		Refrigeration Systems	1	3		Senior elective
		Refrigeration Plants	2	3		Senior elective
St. Louis	Washington University	Air Conditioning		4		Senior requirement
		Advanced A.C.		6		Graduate course
		Refrigeration		3		Elective for M.E. and E.E.
		Air Conditioning				Evening course
Montana						
Bozeman	Montana State College	Heating and A.C.	3Q	3	Junior standing	
		Radiant Heating and Heat Pumps	1Q	3	Heating and A.C.	Senior and graduate elective
New Jersey						
Hoboken	Stevens Inst. of Technology	Air Conditioning				Senior elective
		Refrigeration				Senior elective
Newark	Newark College of Engineering	Refrigeration	1 & 2			12-week evening course
		Heating and A. C.	1 & 2			12-week evening course
New Brunswick	Rutgers University	Heat Transfer	2	4	Heat Power	Covers Heat., Vent., A.C., and Refrigeration. Senior elective
		Heat. and Vent. Eng.	2	3	Heat Transfer	Senior elective
		Refrigeration	1	3		Graduate course
		Air Conditioning	2	4		Graduate course
Princeton	Princeton University	Heating, Ventilating and A.C.			Heat Power Engineering	Combined lecture and drawing room course
New Mexico						
Albuquerque	The University of New Mexico	Refrigeration	1	3	Thermodynamics	Elective
		Air Conditioning	2	3	Thermodynamics	Elective
		Adv. Heat. and A.C.		3		Graduate elective
State College	N. M. College of Agriculture and Mechanic Arts	Heating, Ventilating and A.C.	1 or 2	3		Senior elective
		Refrigeration	1 or 2	3	Thermodynamics	Senior elective
New York						
Brooklyn	Pratt Institute	Refrigeration	2nd yr.	2	Applied Thermo.	All part of a four-year evening course in air conditioning for which a certificate is granted. First year covers basic mathematics and physics.
		Heating Design	3rd yr.	2	Applied Thermo.	
		Ventilating Design	3rd yr.	2	Heating Design	
		A.C. Design	3rd yr.	2	Ventilating Design	
		Evaporative Cooling	4th yr.	1	Applied Thermo.	
		Mech. Equip. of Bldgs.	4th yr.	2		
		Controls	4th yr.	1	A.C. Design	
Ithaca	Cornell University	Refrigeration and A.C.		3	Heat Power Engineering	Elective
New York	Columbia University	Equipment Applications	2	4		For 9th term students
		Air Conditioning	2	3½		Evening course
New York	New York University	Heat. and Ventilating	1		Math. and Physics	Evening extension courses
		Air Conditioning	1		Heating and Ventilating	
		Heat. and A.C. Design	1		Heat. and Vent.; A.C.	
		Elements of Refrig.	1		Math. and Physics	

Engineering Courses Available in Air Conditioning, Refrigeration, Heating and Ventilating—Continued

Location	School	Course	Term Offered	Credit Hours	Prerequisites	Comments
New York (Continued)	New York University	Heating and A.C.	1 & 2	5	Thermodynamics	Senior elective
		Refrigeration	2	3	Thermodynamics	Senior elective
		Heat Pumps	2		Thermodynamics	Graduate course
		Air Conditioning	1		Thermodynamics	Graduate course
Potsdam	Clarkson School of Technology	Heat. and Ventilating	1	2	Thermodynamics	Also covers A.C.
		Refrigeration		2		Senior elective
Syracuse	Syracuse University	Mechanical Refrig.	1	2	El. Thermodynamics	Senior requirement
		Air Conditioning	2	3	El. Thermo.; Heat Transfer	Senior requirement
		Advanced Heating and Ventilation			Steam Power Plant. Eng.; Heat Transfer; A.C.	Graduate course
Troy	Rensselaer Polytechnic Institute	Heat. and Ventilation		2		U. S. Navy students
		Refrigeration		4	Heat Engineering	Senior elective
		Industrial A.C.		4	Heat Engineering	Senior elective
		Heating and A.C.		3		Graduate elective
North Carolina Durham	Duke University	Heating, A.C. and Refrigeration	1 & 2	6	Thermo.; Fluid Mechanics; Heat Transfer	Senior course
		Senior Laboratory				Covers Heat., A.C., and Refrigeration
Raleigh	North Carolina State College of Agriculture and Engineering	Heating and A.C.	1,2 & 3Q	9	Thermodynamics	For advanced undergraduates and graduates
		Refrigeration	2Q	3	Thermodynamics	
		Heating and A.C. Design	1,2 & 3Q	9	Heating and A.C. Mechanical Laboratory	Graduate course
		Heating				10 wk. non-credit extension courses
		Air Conditioning				
North Dakota Fargo	North Dakota Agricultural College	Refrigeration, A.C. and Heat Power	3Q	4	Thermodynamics	Junior E.E.
		Refrigeration and Air Equipment	3Q	4	Thermodynamics	
		Heat. and Ventilating	3Q	2	Mech. Equipment of Bldgs.	Seniors in architect. eng.
		Air Conditioning	2Q	6	Thermodnyamics	Seniors
		Heating Design		2		Elective
Grand Forks	University of North Dakota	Heating and A.C.	1	3	Thermo.; Basic Heat Power	Senior course
		Refrigeration	2	3	Heating and A.C.	Senior elective
Ohio Akron	Univ. of Akron	Heating and A.C.		3	Thermodynamics	Senior course
Cleveland	Case Institute of Technology	Heating, Ventilating and A.C.		4	Thermodynamics and Heat Transfer	Senior elective
		Refrigeration		4	Thermodynamics	Senior elective
Columbus	The Ohio State University	Heating, Ventilating and A.C.	1 & 3Q	3	Heat Transmission	For 4th yr. students
		Refrigeration and A.C.	3Q	3	Heat., Venti'ating and A.C.	Elective
		Refrigeration	1Q	3	Heat., Ventilating and A.C.	For 5th yr. students registered for A.C. and Refrig. option.
		Air Conditioning	2Q	3	Heat., Ventilating and A.C.	
		Heat., Vent., and A.C. Design	3Q	To be arranged		
Dayton	University of Dayton	Heating and A.C.		5		
		Refrigeration		3		
Oklahoma Norman	The University of Oklahoma	Heating, Ventilating, Refrig. and A.C.		4		M.E. requirement
Stillwater	Oklahoma A & M College	Heating and A.C.	2	3	Steam Power Plants	Senior elective
		Refrigeration	1	3	Steam Power Plants; Thermodynamics	Part of senior refrigeration option
		Refrig. Plant Design	2	2	Refrigeration	
		Advanced Refrigeration		3	Refrigeration Pl. Design	Graduate course

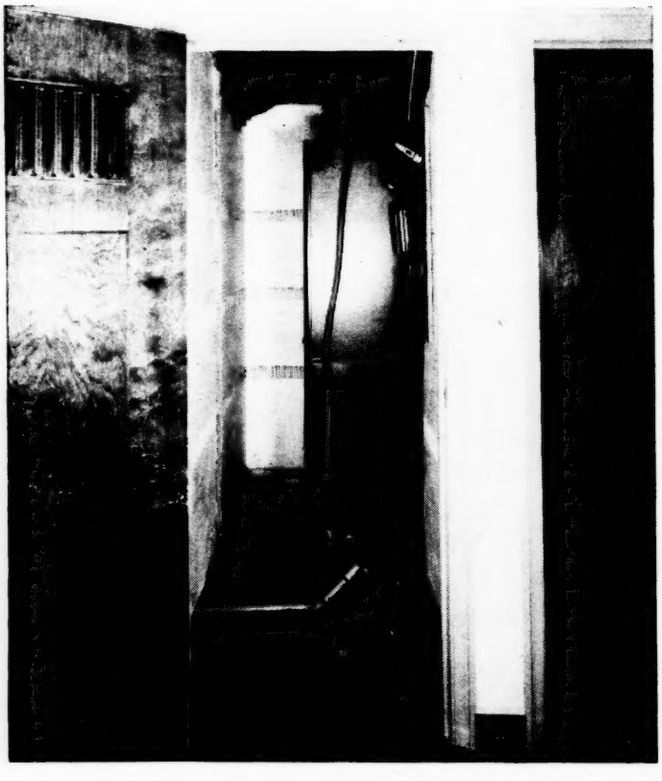
Engineering Courses Available in Air Conditioning, Refrigeration, Heating and Ventilating—Continued

Location	School	Course	Term Offered	Credit Hours	Prerequisites	Comments
Oregon Corvallis	Oregon State College	Heating and A.C.		3	Heat Engineering	Senior electives. Heat. and Vent. option to be established.
		Refrigeration		3	Heat Engineering	
Pennsylvania Bethlehem	Lehigh University	A.C. and Refrigeration	1	3	Thermodynamics	Senior or graduate students
		Air Conditioning	2	3	A.C. and Refrigeration	
Lewisburg	Bucknell University	Refrigeration	1	3	Thermodynamics	Senior elective
		Heating, Ventilating and A.C.	2	4	Thermodynamics	Senior elective
Philadelphia	Drexel University	Heating and A.C.	2	3½	Applied Thermodynamics	Required of seniors
		Refrigeration		3½	Applied Thermodynamics	Senior elective
Pittsburgh	University of Pittsburgh	Refrigeration	1	3	Applied Thermodynamics	Senior course
		Air Conditioning	2	2		Senior course
		Heating, Ventilating and A.C.				Elective
State College	The Pennsylvania State College	Air Conditioning		3		Senior elective
Swarthmore	Swarthmore College	Refrigeration and A.C.	2		Thermodynamics	Senior requirement
Rhode Island Providence	Brown University	Mech. Engineering Practice			Heat and Power	Elective. Includes heating, ventilation and refrig.
Tennessee Knoxville	The University of Tennessee	Refrigeration		3Q	Thermodynamics; Mech. Lab.	Major elective
		Air Conditioning I		3Q	Refrigeration; Heat Transmission	Major elective; also covers heating and ventilating
		Air Conditioning II		3Q	Air Conditioning I	Major elective
Texas Austin	University of Texas	Heating and A.C.	1	3	Physics; Applied Math.	Required of senior architectural students
		Heating and A.C.		3	Thermo.; Heat Engineering	Senior elective
		Refrigeration		3	Thermo.; Heat Engineering	Graduate course
College Station	Agricultural and Mechanical College of Texas	Refrigeration		3	Thermodynamics	Senior elective
		Heating, Ventilating and A.C.		3	Thermodynamics	Senior elective
		Advanced A.C.		4	Heat., Vent. and A.C.	Graduate course
Dallas	Southern Methodist Univ.	A.C. and Refrigeration	1 & 2Q	6	Thermodynamics	Senior elective
Houston	The Rice Institute	Power Plants, Heating, Ventilation and A.C.		10	Thermodynamics and Heat Engines	For seniors
Lubbock	Tex. Technological College	Heating, Ventilating and A.C.	1 & 2	6	Thermodynamics	Senior elective
Utah Salt Lake City	University of Utah	Heating and A.C.		3	Heat Power Engineering	
		Refrigeration		3	Heat Power Eng.; Heat Power Laboratory	
		Advanced Refrigeration		3	Heat Power Engineering; Refrigeration	
Vermont Burlington	Univ. of Vermont	Air Conditioning	1	4	Thermodynamics	Senior elective
Virginia Blacksburg	Virginia Polytechnic Institute	Heating and Ventilation	1Q	4	Thermodynamics	Senior elective
		Air Conditioning	2 & 3Q	8	Thermodynamics	Senior elective
		Refrigeration	2Q	3	Thermodynamics	Senior elective
		Advanced A.C.	1,2 & 3Q	9	Air Conditioning	Graduate course
		Mechanical Equipment of Buildings	1 & 2Q	8	Sophomore Physics	In part, covers Heat. & A.C. Given in Dept. of Arch.

Engineering Courses Available in Air Conditioning, Refrigeration, Heating and Ventilating—Continued

Location	School	Course	Term Offered	Credit Hours	Prerequisites	Comments
Charlottes-ville	University of Virginia	A.C. and Refrigeration	1	3		Senior course
		A.C. and Refrig. Lab.	1	1		Senior course
Washington Pullman	The State College of Washington	Heating and Ventilating	1	3	Junior standing	Elective
		Refrigeration and A.C.	2	2	Thermodynamics	Senior elective
Seattle	University of Washington	Heating and Ventilating		3		Elective
		Refrigeration		3		Elective
Wisconsin Madison	University of Wisconsin	Heating and Ventilating	1 or 2	3	Heat Power Eng. or Thermo. and Heat Power Eng.	Elective
		Air Conditioning	2	2	Heating and Ventilating	Elective
		Refrigeration	1 or 2	3	Heat Power Eng. or Thermo. and Heat Power Eng.	Elective
		Heat. and Ventilating Laboratory	2	2	Elementary Testing or Heat Power Testing	Elective
Milwaukee	Marquette University	Heating and Ventilating	1Q	3	Heat Engines	4th year
		Refrigeration	3Q	3	Heat Engines and Thermo.	4th year
		Refrigeration Lab.		2	Mech. Eng. Lab. and Thermodynamics	Elective
Wyoming Laramie	University of Wyoming	Heating, Ventilating and A.C.	3Q	3	Heat Transmission	Required for seniors
		Refrigeration		3	Thermodynamics	Senior elective
		Mech. Equipment of Buildings				Required of C.E. enrolled for architect. options

Air Conditioning for a Three-Room Suite



Packaged air conditioning unit installed in a clothes closet to serve a three-room hotel suite.

Packaged air conditioning equipment was placed in a large corner suite in the Dayton, Ohio, Biltmore Hotel in a manner to provide a built-in look. Here a three-ton capacity Frigidaire air conditioning unit was installed by the Refrigeration Equipment Co. of Dayton.

The air conditioning unit, proper, is housed in a clothes closet off the entrance alcove of the suite, which is comprised of a living room, bedroom and bath. Installed facing the doorway of the closet, the unit is completely hidden by a stained plywood panel which replaces the door itself. The return grille of the unit extends through the panel; a small recess below holds the control switch. Inside the closet, all plumbing and electrical connections remain hidden from the view of the suite occupants.

The conditioner was installed without its air distribution hood. Instead, it is connected to a short air distribution duct about 20 ft in length, installed between the walls of the living room and bedroom. This duct is completely insulated to prevent heat loss. Discharge grilles near the ceiling serve both areas.

A thermostatic switch affords completely automatic temperature control. Cool, filtered and dehumidified air is circulated throughout the conditioned area. The unit is easily accessible for servicing or maintenance work, either from within the closet or at the front where the entire wooden panel can be removed.

Problems In Adding a Second Fuel Oil Tank

T. W. REYNOLDS

Chief, Air Conditioning Division, Abbott, Merkt & Co., New York

Based on an actual installation, the author discusses the present varied thinking on the part of experts about an everyday problem, currently quite common.

DRESSING up the old road into my place with new modern construction and surface finish would seem to have nothing to do with the addition of a second fuel oil tank to the house, but one thing led to another and it did. Some old troublesome drains had first to be repaired and redesigned for permanency under the more expensive new road, after which my thoughts turned to other ways of preserving the road. For example, after last winter's experience, who wants to shovel snow, but if snow isn't shoveled oil trucks are apt to wander around and spoil things. So why not add more oil storage to reduce the number of trips and let the snow stay put until it melted, hoping this will be before the oil reserves are exhausted. So you secure a couple of *close* bids for the oil tank installation; one at $225, the other at $100, and anyone knows which was accepted. Incidentally, the low bid of $100 is four times the bid for the same job at the time the house was built 14 years ago.

Plenty of advice was received on just how the two oil tanks should be connected. Although the tanks are at different levels (see sketch), the writer still thought it would be just a simple matter of adding a tank tied in with pipe. It developed, however, that an engineer friend in New York differed with the local contractor and both differed with the experts from the oil burner company, with two of the latter differing with one another, though all were not so far apart when the writer, as coordinator, got through analyzing the problem.

No doubt the installation would have been made much quicker had it been less engineered; in any event, the interesting discussion which revolved around this installation is but an example of present day discussions going on in many a hamlet where a second 275-gal tank may now be added. Even before this, there has always been a considerable difference in opinion regarding the piping of oil installations. The experts have had such different experiences.

One may ask why the problem was not made more simple by merely adding alongside the old tank a new tank of similar shape and size. Engineers do make provision for the future, so there was room inside the unexcavated space for four 275-gal tanks, though only two would be allowed, according to the village and insurance requirements. It was a nice space, but upon investigation found unusable for the purpose in mind, for the old tank had gone in before the boiler was installed rather close to the entrance to this space. How now could one get a new tank past the boiler into the unexcavated space? No provision had been made for that, although the 14-year-old tank cannot last forever. Sooner or later it must be replaced.

One contractor said he could get a tank in, a second contractor said he couldn't, or anybody else for that matter. This particular phase of the discussions was soon settled since no tanks were found available in the same size and shape as the old tank, except with connections on the narrow side. By removing a few closets a new tank was installed low down outside of the excavated space, as shown in the accompanying sketch, and while there is one or two things about the new installation which would not have happened had the writer been always present, it is nevertheless a good installation.

The new tank is piped with suction at its bottom, making thereby a gravity feed, though it would have been better had it been piped to the top to give the same protection as with the old tank, thus guarding against emptying of the low tank should breakage occur in a low oil line. To make the change-over, the suction of the low tank would be connected to the top of this tank where the return is now shown connected. The return would then be connected to a tee at the vent alarm fitting. The suction would, of course, have a dip pipe in the tank and a vacuum breaker or approved anti-syphon device.

In a two-tank installation one tank cannot be one-pipe (suction only) and the other two-pipe, as one source of information said, though they both can be one or the other. One-pipe, or single stage as it is called, can be accomplished by simple adjustment at most oil pumps, so that an internal or external by-pass is immediately made operative to pump the excess oil around that is not consumed by the burner. Return line to high tank in the present case would then be disconnected and plugged.

Operation of only one tank at a time is allowed, hence there are two sets of valves, one set for each tank, the two sets being kept apart to avoid confusion. Operation should preferably be on the low tank, so it is said, keeping the upper tank for emergency storage. This avoids the possibility of oil in the high tank eventually lowering below the bottom of the dip pipe on the suction, thus causing sputtering of burner due to air entering the dip pipe. The writer, however, does not feel that this is anything to worry about, since one need not let the tank get that low in oil; furthermore, in a two-pipe job, any air in the suction pipe can be vented back to the tank by way of the return pipe.

The writer prefers to run on the low tank for other reasons. For example, when the low tank was being

filled with oil for the first time the truck driver paid no attention to the vent alarm which hisses almost in one's face if one does not walk away. As a consequence, the oil filled up in the fill pipe and rose in the vent pipe, testing out the new piping system and after a time showing up a leak at the vent alarm fitting, and also at the gage. Incidentally these gages are temperamental and won't take much pressure.

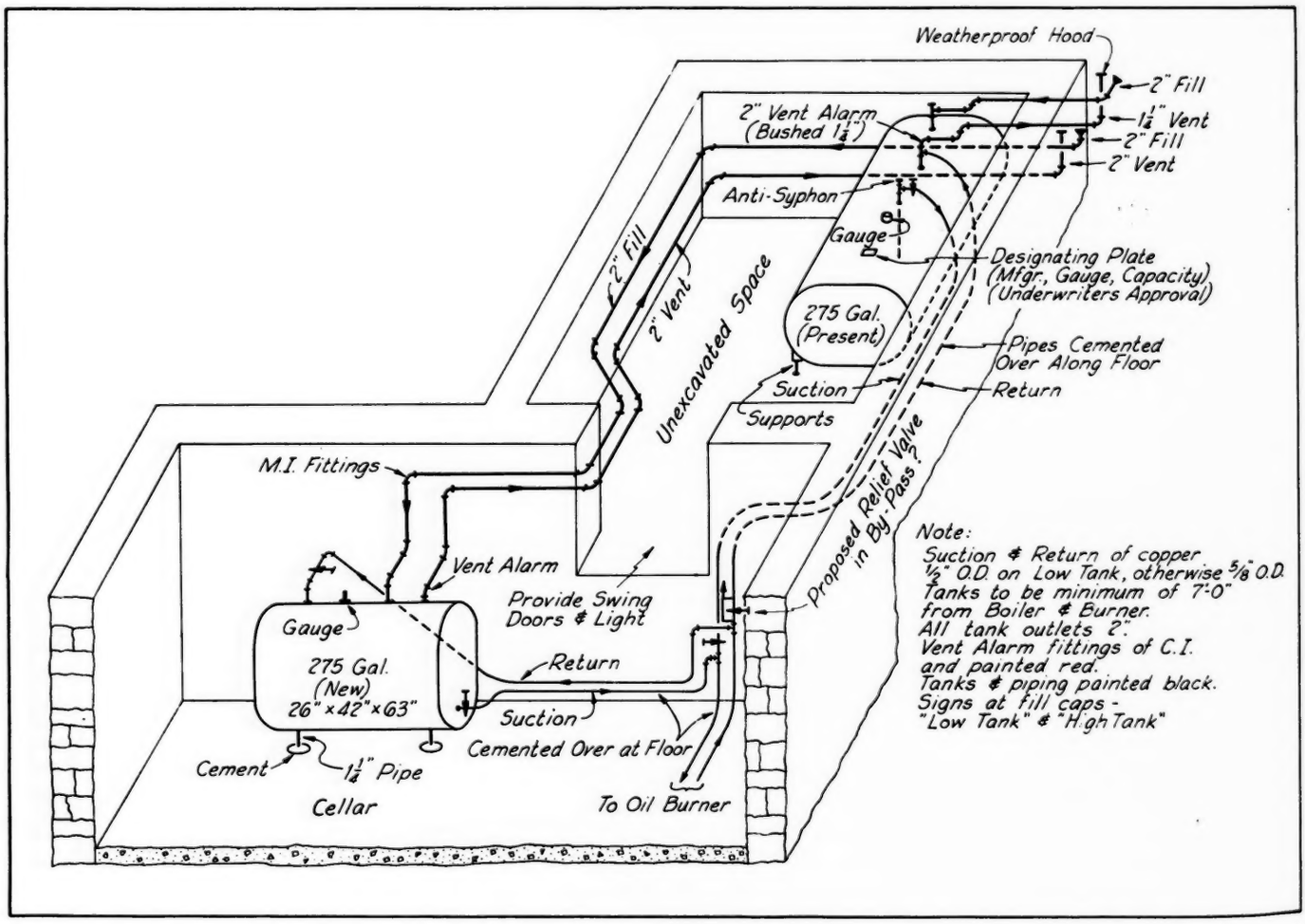
In operation, when the low tank is emptied, one should close its two valves and then open the other two. Suppose, however, that one forgot to open the return valve on the high tank, or that its gate become detached from the spindle. A dangerous pressure would then build up and would require* a relief valve set in a by-pass around either return valve, at least so it was said. Nevertheless, the writer omitted the relief valve, since it would seem that pressure would soon stop the pump and that is all there would be to it. A load would be imposed on the motor so that the usual overload protection should stop the burner. In any event, the relief valve, if used at all, would best be connected into the suction rather than by-pass the valve.

Of course, there are a few things that could happen if one foolishly manipulates the valves. For example, closing the return valve of the low tank and the suction valve of the high tank, all other valves being left open, would cause oil to be pumped from the low tank to the high tank. Now, the oil burner nozzle in question has a capacity 2½ gal per hr and the pump probably about twice as much, so the excess oil of 2 gal per hr could in time collect in quantity as discharged outdoors from the vent, particularly so, as the high tank should already be full of oil when the action started.

Usual ordinances permit joining of two vents together into one 1¼ inch vent, but separate 2 inch vents were used in the present case. These things prevent oil from spilling out the vent as sometimes happens and also gives easier venting at but slight additional cost; furthermore, as the tank ages it is desirable to keep the pressure on the tank down. Fittings are malleable iron, but are often cast iron with heavy oil. Sweeps are used at turns, except at end of runs where fittings are used. Pipes are run along walls near floors and where near floors are cemented over as a protection against mechanical injury. Vent alarms are each in a cast-iron elbow which is painted red for the benefit of the oil truck driver. Pipes should not be galvanized, not even the vent. Scale from galvanizing could drop into the tank and might eventually cause trouble at the burner. Piping of ⅝ inch size makes pumping easier, but ⅜ inch is satisfactory.

Outlets near or in the tank bottoms are not permissible, except on 275-gal tanks. On the tank shown, the

*Must be provided in New York City.



Connections for two oil tanks.

suction outlet is within 2 inches from the bottom of the tank, though it is not good to draw the oil down to a point where moisture and sediment may exist. The tank is supported on pipes which must be cemented in as shown. The fill cap to the old tank was sloped as shown, in which position its indentations shed water more readily. This slope is not necessary, since a few turns of the wrench in screwing off the cap sheds what little water there is that has not already evaporated after a rain. The slope may even become objectionable due to the liability of greater oil spillage. Unenclosed tanks should have a free unobstructed horizontal distance of 7 ft from any flame or heating apparatus, such as the boiler or burner. Oil leakage spreads out over a floor and oil vapors can reach a boiler or burner too near; too, boilers sometimes overheat to a high degree when by chance they run dry. No doubt the ruling on distance should be modified to read "That portion of the tank which is not 7 ft away." With most tanks, however, their length is such that it is as cheap to cover all as part.

Inside tanks above ground do not have to be painted, though it is best to give tank and piping one coat of black paint for protection and appearance. In New York City tanks are shipped to the job with one light coat of paint, which is no doubt sufficient, but unless specified otherwise, one coat is all the tank gets. Nevertheless, New York City rules call for tanks, other than those inside above ground, to be thoroughly cleaned and coated on the outside with two coats of red lead and coated at the site with hot tar, asphalt, or other equivalent rust resisting materials. Few seem to pay any attention to the ruling and no action seems ever to be taken where the rule is avoided. Nor does anyone pay any attention to the designating plates on the tank. For no particular reason, the tanks are often placed along a wall in such a way that the plates read backward. On top of this, they are painted over with the rest of the tank, making more certain that they cannot be read at all. The law does not say they have to be read. It simply rules that they must be on the tank.

Piping and tanks of 275-gal capacity may be tested by pressure from the oil truck as it fills the system. Tanks of greater capacity require hydrostatic test with water rather than oil, as oil vapors from leakage are not as safe, even though the oil burner flame is supposed to be out during any test which may be allowed with oil. Rulings allow outside tanks of over 275-gal capacity to be tested with oil in freezing weather and in actuality this sufferance seems to be extended to inside tanks. One may plead a hardship, such as difficulty of thorough drainage and freezing if water were used, though the real hardship is a truck standing by at $5 per hr just to drain a tank of water. Anyhow, oil is more penetrating in showing up leaks when given a little time in which to penetrate. During the test, a plug is substituted for the gage. This prevents damage to the gage. With outdoor tanks, it is advisable to immediately fill them with oil. This prevents floating should it rain before the weight of earth or other permanent cover is over the tanks. Some tanks even require positive anchorage.

The hum in a tank has been a troublemaker for many years. It is present in the new tank of the installation shown and may go away with time, even as it did with the oil tank years ago. It was reduced somewhat by removing the return pipe, with its vibrations, away from contact with the side of the tank. An antihum valve may be installed, or other method used, but in most cases the changes must be made with considerable care or the burner flame becomes erratic. Perhaps better to keep the hum than to develop some other trouble that is more annoying.

Gas Masks Protect Ice Cream Flavor

Milk, butter fat, coatings and other ice cream ingredients are very receptive to foreign odors. Flavor contamination in ice cream manufacture must be guarded against at all times. The Goldenrod Ice Cream Co. of Chicago installed activated carbon air recovery units in the plant's cooling room to help control foreign odors.

Because of the extremely low temperatures maintained, usually —30F, the air in the cooling room has lower moisture and other vapor pressures than the surrounding area. As a result vapors and their attendant odors from street traffic, industrial plants, garages, etc., will have a tendency to invade the room. Most of the time the room is adequately sealed and the possibility of contamination is present only during loading periods when the conveyor exits are open.

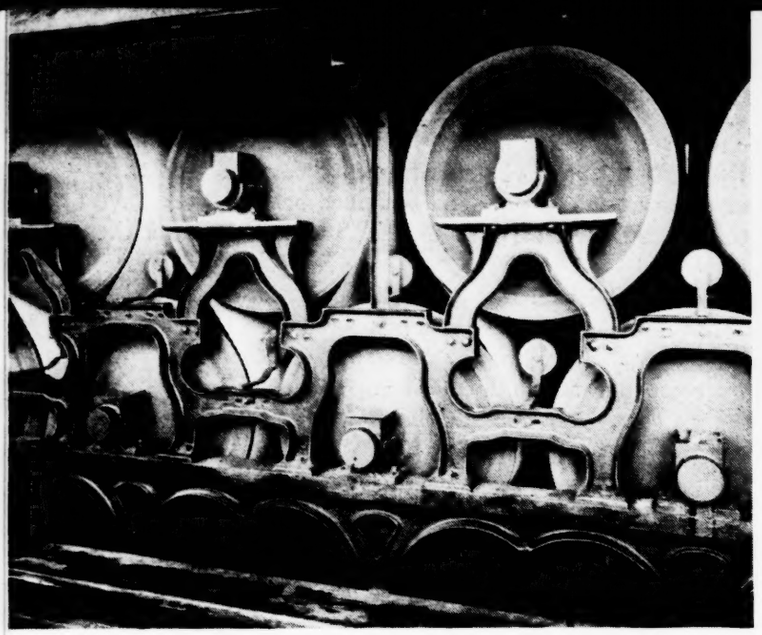
The size of the cooling room is 96,000 cu ft and it is served by two air recovery units, each with a capacity of 1500 cfm. The total 3000 cfm provides about two air turnovers per hour. The units consist of 60 activated carbon-filled canisters, two 1500 cfm fans, casings and blast deflectors.

Plant superintendent and production manager Max F. Halberstadt says that this equipment has enabled them to double the former storage time.

In addition to odor filtration a further precaution is taken by pressurizing the cooling room, the only such ice cream cooling room, it is believed, that is so protected.

Damaging odors can be insidious. Often they're in such low concentration that they can't be detected by human beings. The amount of gaseous impurities sufficient to contaminate air is so small as to be unbelievable. Less than one part of odorous substances per million parts of air, or one ten-thousandth of one percent is enough.

W. B. Connor Engineering Corp. of New York manufactures activated carbon air recovery equipment.



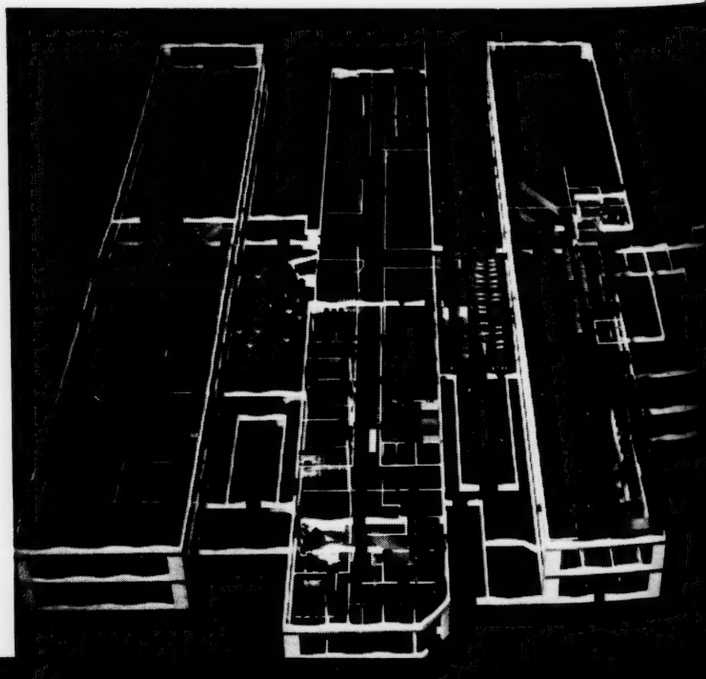
(Above) To meet heavy demand for paperboard for boxes and cartons, the Durham Paperboard Company, Riegelsville, Pa., has been able to increase production by about 10% by installing a warm air drying system to reduce drying time. Warm air tubes are mounted on brackets between the steam drums. Perforations on three sides of the tubes direct the warm air against the paperboard. Exhaust fans pull moisture-laden air away from the machine to an overhead hood. Warm air is supplied by a Dravo direct-fired heater equipped with a booster fan and supply duct to the drier.

(Above) At the invitation of the National Security Resources Board, an informal task group representing cast iron boiler and radiator manufacturers met in Washington to discuss possible plans for mobilization in case of need. Shown here are (left to right) George Hoffman, manager, Plumbing and Heating Dept., Crane Co., Chicago, Ill.; S. K. Smith, president, H. B. Smith Co., Inc., Westfield, Mass.; D. D. Couch, vice president, American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.; H. H. Smith, United States Radiator Corp., Detroit, Mich.; W. R. Stockwell, vice president and general manager, Weil-McLain Co., Michigan City, Ind.; John P. Kottcamp, NSRB's director of construction materials division; Walter R. Crowe, NSRB; L. N. Hunter, vice president for research, The National Radiator Co., Johnstown, Pa.; G. L. Harberger, general sales manager, The Eastern Foundry Co, Boyertown, Pa.; William B. Westcott, Jr., secretary and treasurer, Utica Radiator Corp., Utica, N. Y.; R. E. Ferry, general manager, Institute of Boiler & Radiator Manufacturers, New York, N. Y.

Picture

(Left) One of the latest designs in open fireplace heating was shown at a building exhibition in London. Built to heat three rooms with one fire, the construction allows air to pass through intakes under the floor and then through flues to heat upper rooms.

(Below) Lucite models on ¼-in. scale of single and multi-story buildings are built to blueprint dimensions with scale grid floors by Visual Planning Equipment Co., Inc., of Oakmont, Pa. Models are complete with all columns, stairways, elevator shafts and other physical characteristics.



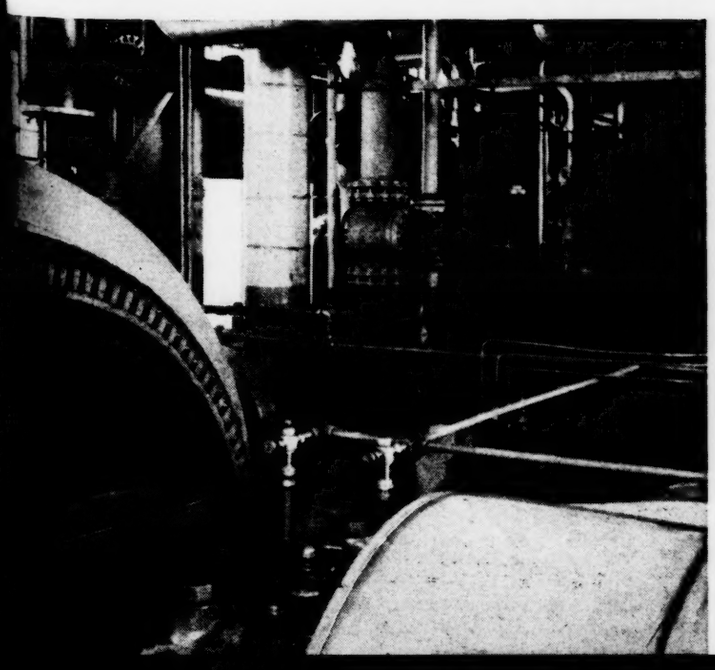
(Above) An Army Air Force "Flying Boxcar," one of two C-82's, on a mission authorized last summer by Secretary of War Kenneth Royall, loads 13,700 pounds of Trane "wall fin" at La Crosse, Wis., for the new 160-bed emergency-built Central Carolina Convalescent Hospital at polio-stricken Greensboro, North Carolina. Trane workmen turned out the wall fin in a week—a job ordinarily requiring four to six weeks.

(Right) Constructed in nine months, the new Saxony Hotel at Miami Beach is the first American hotel, according to Minneapolis-Honeywell engineers, to use automatic air conditioning controls in each room. Owner George B. Sax paid some workmen as much as $472 a week with overtime to insure hotel's opening for the season.

Paragraphs

(Right) In order to mount vertical down-blow unit heaters at a maximum height of 13 ft, Kno-draft air diffusers were attached to eliminate drafts. Heaters deliver 11,000 cfm projected by diffusers to cover a 75 ft radius.

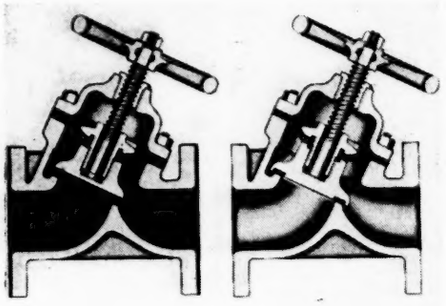
(Below) One of the processes in making aviation gasoline involves the manufacture of alkylate, during which considerable heat is generated. Refrigeration is needed to keep the temperature at 45F for the process. At Shell's Woodridge Refinery, cooling is handled by a battery of ammonia compressors. Total capacity is 1500 tons per day.



NEWS OF EQUIPMENT AND MATERIALS

Crane Diaphragm Valve

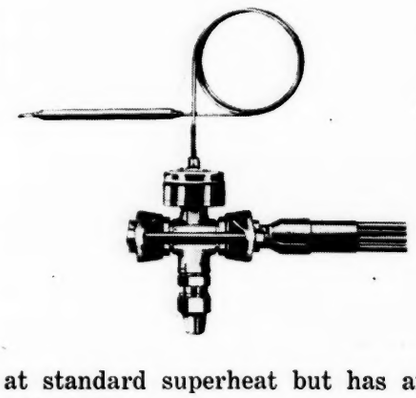
NAME—Crane diaphragm valve.
PURPOSE—Valve utilizing a new design principle that limits the diaphragm function to sealing the bonnet only.



FEATURES — A separate seating member gives positive control of flow independently of the diaphragm and reduces the flexing to which the diaphragm is subjected. This is said to eliminate the diaphragm crushing action inherent in designs where the diaphragm itself is used to effect valve closures. Shut-off of flow is positive at all times. Even in the event of diaphragm failure, fluid cannot pass on to the line when the valve is closed. Two types of valves are available, one plain iron and the other neoprene lined and coated. Both types have bolted bonnets. In the unlined valve a newly designed flat-face disc with neoprene insert is used to assure tight seating under all conditions. The neoprene lined and coated valve does not have this insert. Both types have rising stem construction. For sizes 2 in. and smaller, the stem rises through the handwheel. In larger sizes the handwheel is attached to the stem and rises with the stem when operated.
SIZES AND CAPACITIES—Plain iron valves available in ½ to 2 in., inclusive, with screwed ends; in sizes ½ to 4 in., inclusive, with flanged ends. The neoprene lined and coated valves are made with flanged ends only, in sizes ½ through 4 in. The plain iron valves are designed for services not exceeding 150 lb per sq in. at 180F.
MADE BY—*Crane Co., 836 S. Michigan Ave., Chicago 5, Ill.* **119**

A-P Expansion Valve

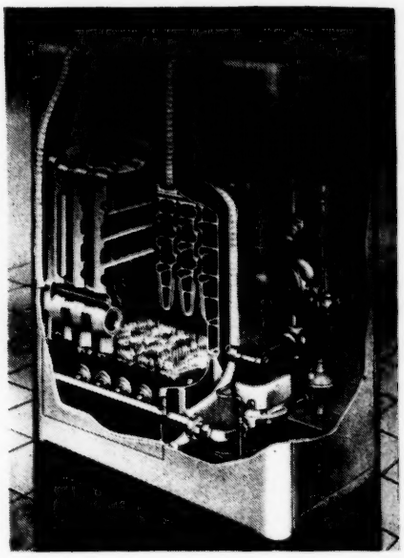
NAME—A-P thermostatic expansion valve, model 216.
PURPOSE—Thermostatic expansion valve for use in refrigeration and air conditioning work.
FEATURES—A multi-outlet distributor installed in the valve is said to make possible uniform and accurate feeding of refrigerant to the coil. Any number of outlets up to 12 can be fed simultaneously. These distributors, available in straight or mushroom type, can be hooked to the expansion valve after they are connected to the coil. Expansion valve itself is small—a liquid-charged unit that can be mounted in any position or ambient temperature with no effect, it is claimed, on the bulb accuracy. Valve is equipped with an extra diaphragm unit that limits operating suction pressure to a 55-lb setting. This diaphragm counteracts the main diaphragm if suction pressure becomes excessive. When an overload no longer exists the valve reverts to normal operation, controlling superheat with a thermostatic bulb and main diaphragm. Valve is set



at standard superheat but has an adjustable range.
SIZES AND CAPACITIES—3.6, 7 and 11 tons; with the multi-outlet distributor, 3, 6.5 and 10 tons.
MADE BY—*Automatic Products Co., 2450 N. 32nd St., Milwaukee 10, Wis.* **120**

National Gas Boiler

NAME — National gas boiler, 22 series.
PURPOSE—Gas boiler for small residential heating.
FEATURES — The raised port cast iron burners, safety pilots, and all other controls are readily reached for servicing through two access doors. Boiler has three nipples instead of the usual two for joining

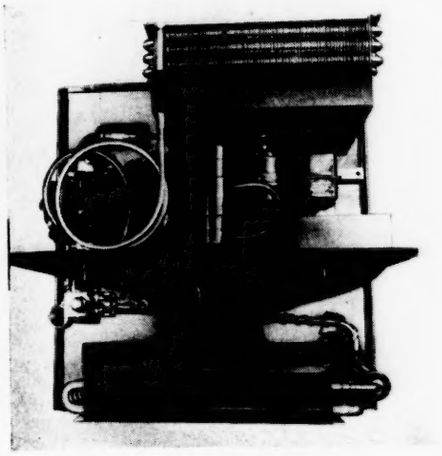


the cast-iron boiler sections. Makers claim that this results in a balanced, positive circulation of water within and between the sections. Long baffles inside the sections provide upward sloping internal tubes which direct the water circulation and add strength to the sections. Efficiency is said to be increased by tapering zig-zag gas passages and an ample amount of extended heating surface. A diaphragm gas valve is installed for use with natural, manufactured and mixed gases, and a solenoid gas valve with 100% shut-off type pilot is provided for liquefied petroleum gases. Standard equipment for manufactured gas includes a pilot line filter, while with natural and mixed gases a pilot line regulator is supplied. Push button igniter equipment can be furnished. Unit is approved by AGA for operation with natural, manufactured, mixed and liquefied petroleum gases.
SIZES AND CAPACITIES — Available in six sizes with net ratings ranging between 110 and 390 sq ft of steam radiation or 175 and 625 sq ft of hot water radiation. Jacket is 42½ in. high, 17⅝ in. wide, and 22⅛ to 37⅜ in. in length.
MADE BY — *The National Radiator Co., Johnstown, Pa.* **121**

Room Air Conditioner

NAME—Model L-750 room air conditioner.

PURPOSE—To cool, dehumidify, filter, and circulate room air at a desired temperature.



FEATURES—Air is drawn from outside or inside the room and is passed through a spun glass filter. The air is mixed, dehumidified, and cooled to the desired room temperature. Unit has a ¾-hp Coplematic twin cylinder semi-hermetic compressor operating at 1725 rpm. Condensing unit is thermostatically controlled. Evaporator and condenser coils are constructed of copper tubes and aluminum fins and end blades. The mechanism is mounted on rubber cushions and springs to reduce noise. Cabinet is designed for easy installation in standard windows without alteration or brackets. Unit projects into the room 12 in. All controls are mounted on a control panel within the unit. Refrigeration system is charged with Freon-12.

SIZES AND CAPACITIES—Air circulation, 296 cfm; cooling capacity, 8541 Btu per hr; size, 16 x 27½ x 27½ in.

LITERATURE AVAILABLE—Circular.

MADE BY—*Louis Engineering Co., Lenco Div., 214 W. Ontario St., Chicago 10, Ill.* **122**

Barber-Colman Outdoor Control

NAME—Barber-Colman dual bulb outdoor reset hot water limit control.

PURPOSE—For use with room thermostats in the control of water temperature in hot water heating systems.

FEATURES—One bulb is mounted outdoors and the other in the boiler water, to control the burner to vary boiler water temperatures with outdoor temperatures in accordance with the pattern determined by the ratio of the control. Room thermostat controls the circulating pump to maintain desired inside temperatures. By varying the boiler water temperature with outdoor temperature, the pump operates almost continuously, and the room thermostat can maintain even temperatures. Unit is available in three fixed ratios of change in outdoor temperature to change in water temperature. Dial setting which indicates minimum water temperature at 70F outdoors is adjustable from 60 to 100F. The liquid filled remote bulbs are connected to a common thermostat

having a single pole, double throw, snap switch action. Capillary tubes 15 ft long are provided between each bulb and the thermostat case.

LITERATURE AVAILABLE — Data sheet F 3833.

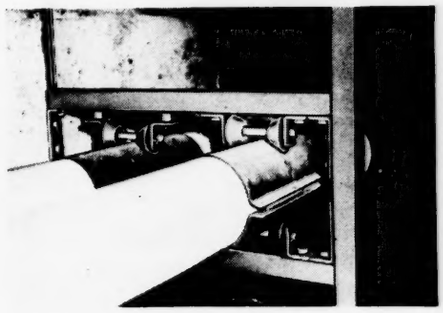
MADE BY — *Barber-Colman Co., Rockford, Ill.* **123**

Unistrut Pipe Support

NAME—Unistrut adjustable pipe support.

PURPOSE—For flexible support of pipe lines.

FEATURES—Supporting rings of the conventional solid rollers have been separated into two distinct tapered rollers having a slope of 30 deg. Pipes varying in size from 1 to 12 in. can be supported on the same rollers having only the axles vary in length. Makers claim that a pipe support holding a 12-in. pipe would be capable of carrying more than 7500 lb without noticeable deformation. Unistrut roller pipe supports mounted on an adjustable frame member permit simple installation of pipe runs.



SIZES AND CAPACITIES—To accommodate pipe 1 to 12 in. in diameter.

LITERATURE AVAILABLE—Circular.

MADE BY—*Unistrut Products Co., 1013 Washington Blvd., Chicago 7, Ill.* **124**

Tube Union

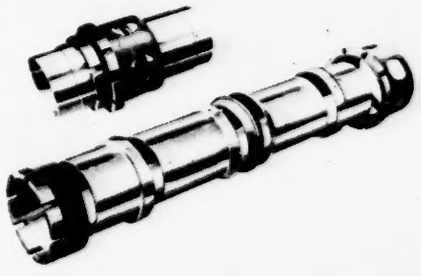
NAME—Roylyn single-thread tube union, 1900 series.

PURPOSE—For joining flared tubes.

FEATURES—Union consists of five parts—a metal seal ring, two sleeves, a threaded clamp ring, and a mating coupling nut. Coupling nut incorporates visual inspection ports. Fast assembly is made possible by the single threaded connection designed for use with standard commercial spanner wrenches. Compared to conventional unions, this coupling is said to represent a weight saving of 1½ lb in the 1½ in. size in steel.

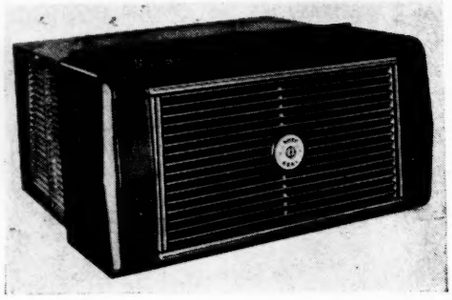
SIZES AND CAPACITIES—Available in 1½, 2, 2½, 3, and 4 in. in either steel or aluminum alloy.

MADE BY—*Roylyn, Inc., 718 W. Wilson Ave., Glendale 3, Calif.* **125**



Quiet Kool Room Conditioner

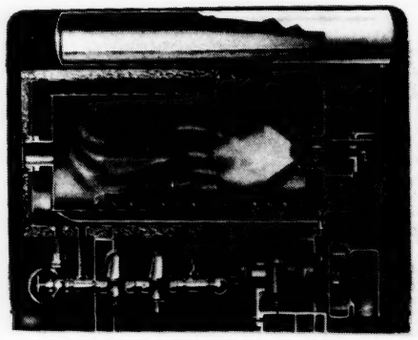
NAME—Quiet Kool room air conditioner, model G-5.
PURPOSE—Room cooling.
FEATURES—Window model is power-



ed by a ½-hp, twin-cylinder compressor. Hermetically sealed refrigeration system uses Freon-12 for the refrigerant. Compressor is mounted on springs and rubber for quiet operation. Cooling coil consists of copper tubes with aluminum or copper cross fins. Evaporator fan is a pressure type blower wheel, 6¼ in. in diameter and 3 in. wide, while the condenser fan is a 12-in. diameter, four-blade aluminum propeller fan. Filters are of the expanded paper viscous coated filter pad type held by a special wire frame. Filters can be reached by lifting the cabinet cover. Switch and damper controls are placed at the front of the cabinet where they are accessible. Thermostat control is available if desired. Unit draws 850 watts when operating on the cooling cycle and 125 watts when ventilating. Air direction may be altered to suit room requirements. Unit projects only 9¾ in. into the room and extends 16 in. outside beyond the window line.
SIZES AND CAPACITIES—Cabinet size, 27¾ in. wide, 13½ in. high, 25¾ in. deep. Room air delivery is 225 cfm and cooling capacity 5500 Btu per hr.
MADE BY—*Quiet-Heet Mfg. Corp., Newark 5, N. J.* **126**

Hot Water Heating

NAME—Petro Aqua-Aire.
PURPOSE—For space heating by means of a hot water heating system which is also capable of heating domestic hot water.
FEATURES — Unit has an insulated welded steel boiler for home heating, complete with expansion tank, motorized heating water circulator, plus flow control valve to prevent unneeded house heating. A stainless steel combustion chamber is provided with radiant heat dissipators. Unit has a Petro oil burner with atomizing fuel nozzle, gear type fuel pump with inbuilt fuel strainer and pressure regulating valve. Burner is operated by a 1/6 hp, 110-volt, a-c motor. Maximum firing rate is 1 gal per hour using No. 2 oil or lighter. A welded steel expansion tank is located on top of and directly connected to the boiler. Seamless copper tube is fully immersed in the horizontal heating system boiler for maximum heat transfer to provide domestic hot water. Opening a hot water faucet



causes the aquastat to start the oil burner which continues to run until the faucet is closed. The hot water circuit for space heating is completely segregated from that for domestic hot water.
SIZES AND CAPACITIES—Capacity of heater, 100,000 Btu per hr. Dimensions of unit are 32½ in. high, 39¼ in. wide, 21¼ in. deep.
LITERATURE AVAILABLE—Illustrated folder.
MADE BY — *Petroleum Heat and Power Co., Stamford, Conn.* **127**

G-E Smoke Indicator

NAME — General Electric smoke density indicator and control.
PURPOSE—To indicate industrial smoke density levels.
FEATURES — Equipment consists of a light source, a phototube holder, and an enclosure containing the required control and incorporating an indicator calibrated in Ringlemann units. If desired, a continuous strip chart type or circular type recorder can be supplied. The water-tight phototube holder can be mounted on

ductwork or on a stack, indoors or outdoors.
OPERATION — A magnetic relay is set to operate when smoke density reaches some predetermined level at which time a blower forces over-the-fire heated air to the firebox until the smoke density drops to approximately 15%. Should the smoke density rise again, the relay is immediately energized. Each time the relay operates, an alarm is sounded to warn the boiler operator to adjust the drafts to insure more complete fuel combustion.
LITERATURE AVAILABLE — Bulletin GEA-5254.
MADE BY—*General Electric Company, Schenectady, N. Y.* **128**

Elastic Glazing Compound

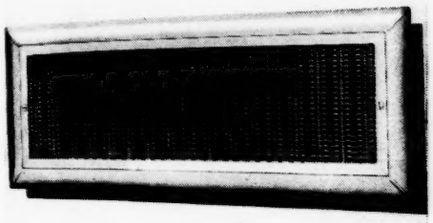
NAME—Armstrong 33 elastic glazing compound.
PURPOSE—For use in the re-glazing of windows and doors.
FEATURES—Compound is said to expand and contract with temperature changes so that it will not chip, crack, or loosen in service. Makers claim that it will not harden in its container as does ordinary putty and that it never becomes lumpy.
MADE BY—*Armstrong Company, 4065 S. LaSalle Street, Chicago 9, Ill.* **129**

Uni-flo Grilles

NAME — Uni-flo double deflection grilles.

PURPOSE—To provide a safe range of air stream adjustment.

FEATURES—Adjustment of the air stream up and down in a vertical plane through the grille is effected by the four-position setting of the



grille core. Lateral adjustment over a wide range is made possible by a simple setting of the vertical bars. Unit is also available with built-in volume control accessible from the face of the grille. This volume control can be used as a shut-off damper with an adjustable limiting device to prevent reopening of the volume control beyond the limit determined at initial balancing of the system. Nested horizontal and vertical fins provide double deflection. Two types of frame styles are available; one flanged and the other with a beaded edge. Sponge rubber gaskets are furnished with the flanged frames to minimize leakage. Grille has removable cores to facilitate duct and grille cleaning.

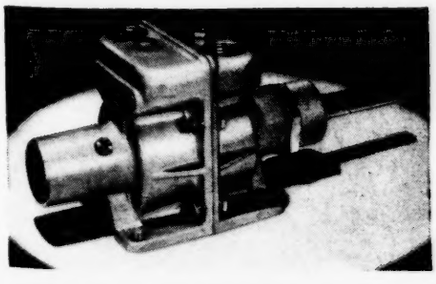
LITERATURE AVAILABLE—Illustrated booklet.

MADE BY — *Barber-Colman Co., Rockford, Ill.* **130**

Eco Pump

NAME—Eco multi-purpose pump.

PURPOSE—Gearless pump adapted to a wide range of applications and the handling of liquids and viscous fluids.



FEATURES—Pump bodies are of stainless steel precision castings or naval bronze forgings. Dual piston design provides a strong flow against pressure. Graphitar bearings are used which require no lubrication. Shaft is of monel metal. Dual eccentric floating pistons are installed. The two or four vertical ports provided permit a wide variety of pipe arrangements.

SIZES AND CAPACITIES—2 to 15 gpm against pressures up to 100 lb per sq in. Unit can operate at speeds from 200 to 3400 rpm. Available in ¼-, ⅜-, ½- and ¾-in. sizes.

LITERATURE AVAILABLE — Bulletin.

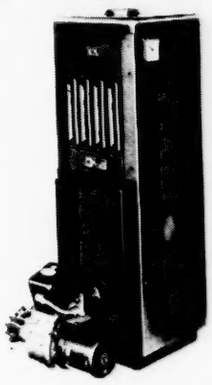
MADE BY—*Eco Engineering Co., 12 New York Avenue, Newark 1, N. J.* **131**

U. S. Water Heater

NAME—U. S. oil-fired automatic water heater, model 5-D.

PURPOSE—For the generation of domestic hot water.

FEATURES—Water heater comes as a complete automatic, packaged unit designed for use by hotels, restaurants and apartments. Heater is shipped assembled with refractory, insulation, and jacket in place. Unit is provided with a U. S. Solar-Flame burner. Controls include an oil burner primary control and water temperature control. Although the guaranteed maximum working pressure is 100 lb per sq in., the hot water storage heaters are tested to 250 lb per sq in. hydrostatic pressure at the factory in accordance with the A.S.M.E. Code.



SIZES AND CAPACITIES—93,000 Btu per hr output. Requires a floor space 18½ in. by 32¾ in.

LITERATURE AVAILABLE—Circular.

MADE BY—*United States Radiator Corp., Detroit 31, Mich.* **132**

Automatic Chlorinator

NAME—Sureclor.

PURPOSE — Hypo-chemical feeder designed to treat water in connection with control of algae and slime formed in cooling towers and cooling water systems.

FEATURES—A water-operated injector is used to produce a vacuum for raising the chlorine solution from the solution container, through check and control valves in the head block. Here the chlorine solution is mixed with water passing through the unit. Operation is automatic and the chlorine solution feeder will start and stop with the flow of water through the unit. A self-cleaning needle valve is used to produce a delayed action in closing of ball check in the head lock to effect a slight back flow and to wash the needle valve and seat after the unit is shut down. Two vulcanized rubber spherical ball check valves prevent back flow into chlorine solution. Unit is fabricated of clear plastic and comes complete with a built-in orthotolodine set for testing the amount of chlorine in the water so that the control valve can be properly set. For small installations, household bleaches may be used as chlorinating agent and for installations of 25 gpm and over, commercial laundry bleach is used.

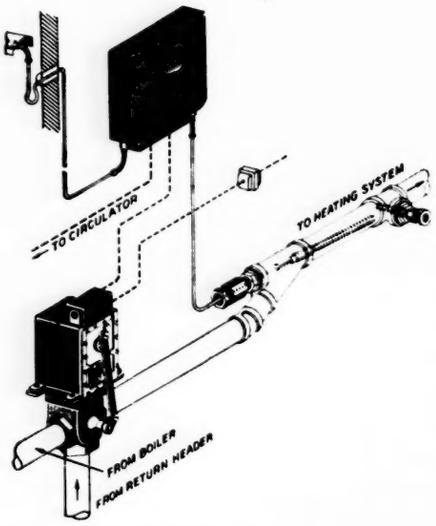
SIZES AND CAPACITIES—Made in one model to handle from 5 cc to 4 fluid ounces of chlorine solution per minute.

MADE BY—*Paddock Engineering Co. of Texas, 3727 Atwell St., Dallas 9, Tex.* **133**

Webster Hot Water Control

NAME—Webster type CF-2 continuous flow hot water heating control.

PURPOSE—To continuously circulate water in the heating system whenever the outdoor temperature is below 70F.



FEATURES—Control consists of two basic components, (1) control unit, and (2) control valve—a three-way mixing valve. In operation the components work together to produce the desired temperature results. Unit incorporates two thermostatic bulbs, one of which is located outdoors, preferably on a north wall, and the other is a thermostatic bulb located in the hot water supply main a short distance beyond the mixing valve. These thermostats automatically adjust the mixing valve by passing hotter water into the supply main if outdoor thermostat calls for greater demand, and reduces the amount of hot water added if recirculated water from the system is warm enough to do the job. A switch is installed on the control to provide fully automatic operation, a shut off of all heat, or a turn on at full heat for rapid heating up. Control has a variator which is a manual control by which temperature of supply main water may be increased above the temperature required by outdoor temperature, or decreased. Where optional automatic thermostat with clock is provided, variator may be left at a normal setting. For example, a setting toward more heat may be provided during cloudy, damp weather, or a setting toward less heat for warm, sunny days. The circulator cut-out switch is factory set to shut off the circulator at 70F outdoor temperature. However, this can be adjusted to some other value.

LITERATURE AVAILABLE — Service bulletin S-250.

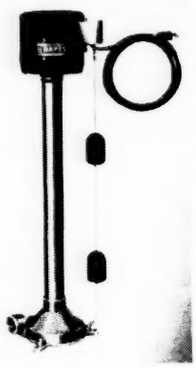
MADE BY — *Warren Webster & Company, Camden, N. J.* 134

Barnes Cellar Drainer

NAME—Barnes S-14 cellar drainer.

PURPOSE — Cellar drainer for high capacities at high heads.

FEATURES—Unit is provided with a floatless switch mechanism that is minus the usual ball and switch rod. Instead, balanced floats of solid neoprene are connected to the operating switch by a stainless steel cable. This switch mechanism is said to eliminate the possibility of float balls jamming or sinking. A brass suction screen is placed on top where it can be easily cleaned. A U-cup neoprene impeller seal prevents recirculation of water within the pump between the suction and discharge sides. A self-lubricating carbon bearing keeps the pump shaft in alignment at the underwater point of assembly. A brass column and solid bronze shaft are used to avoid corrosion. Pump has a bronze body and impeller.



SIZES AND CAPACITIES — Delivers 1950 gph at a 15-ft head, and 1475 gph at a 25-ft head.

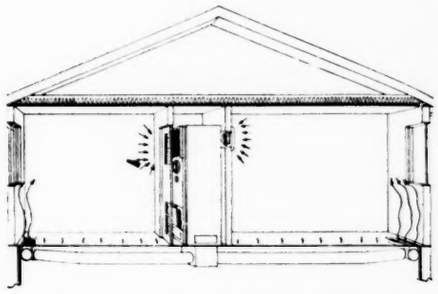
MADE BY—*Barnes Manufacturing Co., Mansfield, Ohio.* 135

International Warm Air Furnace

NAME—International R-9 oil or gas operated warm air furnace.

PURPOSE—To provide low cost heating system for ranch type and basementless homes, utilizing a combined radiant heating and circulating warm air system.

FEATURES—Warm air is distributed under the floors at the perimeter of the home, permitting heat to rise up the walls to overcome the problem of cold air washing down the walls and over the floors. Special warm air outlets are placed under each window to eliminate down-draft of cool air. Arrows in illustration show warm air travel. When the rising warm air reaches the ceiling of the room, a forced air blower located in the top of the furnace draws this warm top air layer into the furnace and recirculates it down and through the heated system. The warm air furnace forces the heated air out at the bottom. Furnace blower is cradled on resilient springs and operates without a-c hum or vibration. Automatic limit control governs the temperature of warm air in the furnace; an automatic fan control starts the fan when air is heated and stops the fan before cooled air can be circulated. A humidifier automatically maintains proper air humidity. Oil flow is metered to the burner to conserve fuel. An automatic control starts the forced-draft blower when the oil flow starts. Furnace is supplied as a packaged unit with all essential parts built in and all electrical controls wired. To make metal duct connections at sides, front, back or underneath the furnace, knock-out blanks are provided. The unit was designed for easy, fast installation with minimum labor.

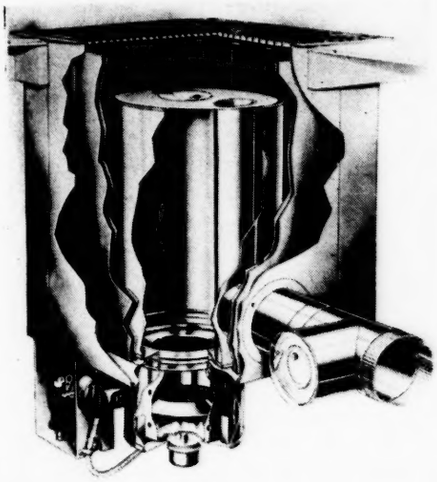


SIZES AND CAPACITIES—Furnace output is 100,000 Btu. Size, 22⅛ in. wide, 27¾ in. deep, and 82¾ in. high.

MADE BY—*International Oil Burner Co., St. Louis, Mo.* 136

Delta Floor Furnace

NAME—Delta floor furnace.
PURPOSE—To provide a complete packaged oil-fired automatic floor furnace for small homes.



FEATURES—As the unit occupies a floor space 24 in. square, not more than one beam has to be cut away in making the installation. A booster fan for forced draft is said to provide high burning efficiency. The cold air return is double baffled to prevent expansion noises. Floor grating is of heavy gage steel construction. All operating controls and electric switch are assembled at the factory and are mounted directly under an easily removable cover at the side of the floor grating. Furnace has a built-in high limit thermostat. Vaporizing burner uses No. 1 or No. 2 oil and has a maximum oil consumption of 0.6 gal per hr. Inside liners are of 28-gage galvanized steel while the outside case is 24-gage galvanized steel.
SIZES AND CAPACITIES — Overall measurement, 24 x 24 x 44 in. Output, 50,000 Btu per hr.
DISTRIBUTED BY — *Delta Heating Corp., 85-07 Northern Blvd., Jackson Heights, N. Y.* **137**

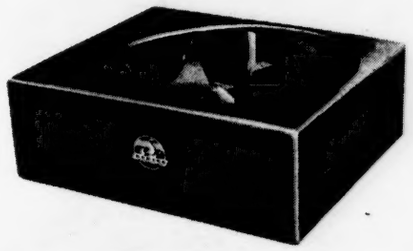
Guiberson Heater

NAME—Clean-Flame, model DC-750 low-boy oil-fired heater.
PURPOSE—Space heating.
FEATURES—A rheostat control permits full directed heat up to 900 cfm or as little of that amount as desired, through control of the propeller type fan speed. Heat is directed to the floor through fixed louvers. The heat exchanger is L-shaped. This causes some of the air to be heated and to pass out through the top grilles as additional air is drawn from the back of the heater and forced out over the heat exchanger and through the bottom front louvers by the fan action. The burner admits a stream of pre-heated air to the flame in the heat exchanger producing maximum heat away from the oil in the vaporizing pan so that the pan remains at a relatively low temperature, thereby limiting the formation of carbon. An air gate is linked to the valve control rod in such a manner that the air opening is automatically set for the most efficient fuel-air ratio at all valve positions.

SIZES AND CAPACITIES—75,000 Btu per hr.
MADE BY—*The Guiberson Corp., 1000 Forest Ave., Dallas, Tex.* .. **138**

Viking Attic Fan

NAME—Viking 622 attic fan package.
PURPOSE—House ventilation.
FEATURES—A 22-in., 3-blade fan rated at 3100 cfm is belt-driven by a ¼-hp, 110-volt, 60-cycle, ball bearing motor. The package is shipped complete with all materials necessary for installation. It includes attic fan, resilient mounting, felt sealing strips, automatic ceiling shutter, automatic electric timer, and a safety fusible ring. For installation, a 25 x 29-in. opening is made in the ceiling to accommodate the fan. The automatic timer is built into the fan casing to eliminate the necessity of a wall switch leg. The hinged automatic ceiling shutters can be lowered for cleaning and for servicing the fan from below.



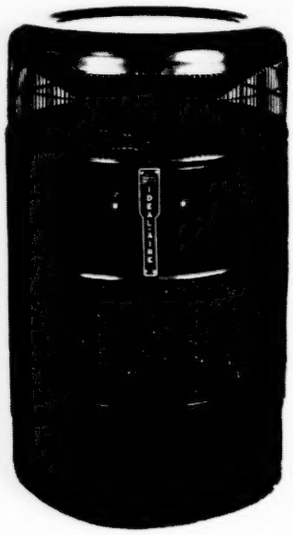
MADE BY—*Viking Air Conditioning Corp., 5600 Walworth Ave., Cleveland 2, Ohio.* **139**

Psychrometric Chart

NAME — Schwerin psychrometric chart.
PURPOSE—Direct-reading psychrometric chart.
FEATURES—The direct-reading circular chart measures 9 in. in diameter and is designed to determine accurately and rapidly all properties of air when only two properties are known. The front of the chart has graduations in wet-bulb temperature; dry-bulb temperature; dew-point; specific volume, and scales to determine moisture content in gal per lb; vapor pressure in lb per sq in.; total heat in Btu per lb of dry air. On the reverse side is a standard psychrometric chart and an explanation of how to use it.
MADE BY—*Schwerin Air Conditioning Corp., 570 Lexington Ave., New York, N. Y.* **140**

Ideal-Aire Cooler

NAME—Ideal-Aire spot cooler.
PURPOSE — Portable evaporative room cooler for home or office use.
FEATURES—Unit is portable and may be moved on ball-bearing roll-



ers to any place desired. It operates on the evaporative cooling principle and delivers cooled and washed air. Filters are made of fiber glass. No water connection is required as the unit has a water reservoir of 7 gal capacity and an hermetically sealed pump which operates submerged in oil to elevate the water in the cooler. The 4-blade, 16-in. fan is operated by a 1/15-hp motor.
SIZES AND CAPACITIES—Rated at 2250 cfm with a dry pack, and 1960 cfm with a wet pack. Height, 28 in., diameter, 18 in.
MADE BY—*The Ideal-Aire Inc., 4801 Lemmon Avenue, Dallas, Tex.* **141**

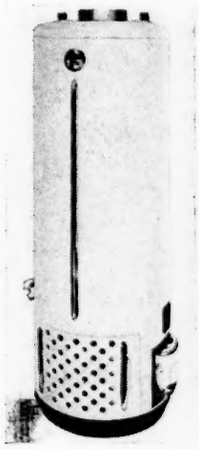
Hastings Air Meter

NAME—Hastings air meter.
PURPOSE—Portable instrument, including power pack, for the accurate measurement of air flow.
FEATURES — Air meter probe used with instrument is an electrical hot wire type pickup, ½ in. in diameter and 4⅞ in. long. It may be plugged directly into the meter which weighs 24 oz or it may be used with an extension lead so that remote indication is possible. Meter is a plug-in instrument. It draws less than 2 watts and may be plugged into the nearest 110-volt, 60-cycle outlet, or connected to a small battery that can be supplied. Meter movement is provided with jewel bearings.
OPERATION—Meter operates from a noble metal thermopile placed in an air stream. The hot junctions of the thermopile are heated by passing alternating current through them. The cold junctions are prevented from being heated by lowering their resistance and by increasing the heat conductivity away from these junctions. A d-c thermal voltage is generated between the hot and cold junctions of the thermopile. Flow of air by the thermopile tends to bring the hot and cold junctions to the same temperature, thus decreasing the output from the thermopile. This voltage output is used to measure the speed of air supplied by the thermopile.
SIZES AND CAPACITIES—Meter can

detect velocities from 5 to 6000 fpm.
LITERATURE AVAILABLE—Illustrated folder.
MADE BY — *Hastings Instrument Co., Inc., Hampton, Va.* **142**

Pro-Therm Water Heater

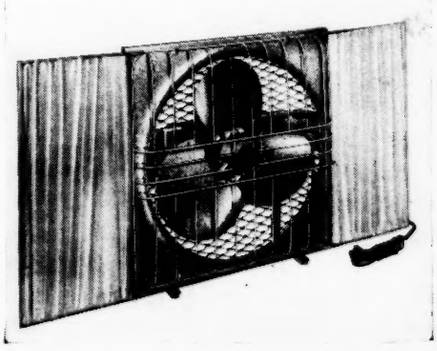
NAME—Pro-Therm automatic oil-fired water heater.
PURPOSE — To supply an ample amount of domestic hot water.
FEATURES—Oil-metering control is recessed into casing to save installation space, but is readily accessible for service and adjustment. Control includes automatic shut-off valve. Conveniently located temperature adjustment knob is used for automatically maintaining desired water temperature. Burner operates in conjunction with large combustion flue. Fiberglas and corrugated asbestos insulation are used. Combination draft regulator and lighting door are furnished with unit. Outer casing is finished in white baked enamel with stainless steel trim. Unit is approved by Underwriters' Laboratories, Inc., for installation on combustible floors.



SIZES—Available in 30- and 50-gal capacities. Overall height 53 in. Casing diameter 18 in. for 30-gal size; 22 in. for 50-gal size.
MADE BY—*Thermo-Products, Inc., North Judson, Ind.* **143**

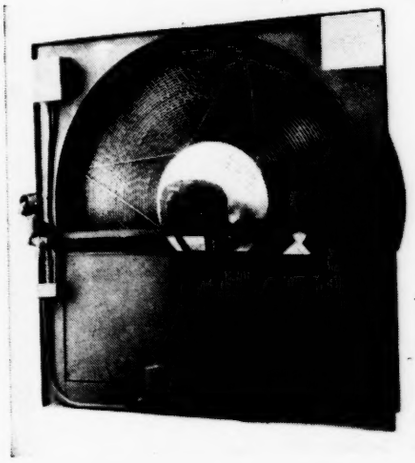
Lau Fan

NAME—Lau P-18 portable fan.
PURPOSE—Room cooler and ventilator.
FEATURES—While unit can be placed anywhere in the room it is provided with removable, plastic side expanders so that it can be fitted inside a window frame. Unit is portable with a carrying handle and is provided with 10 ft of extension cord. Fan is operated by a 3-speed motor and is capable of moving 1800 cfm.
SIZES AND CAPACITIES — 22 in. square by 7 11/16 in. deep.
MADE BY—*The Lau Blower Co., Dayton 7, Ohio.* **144**



Rotary Coolers

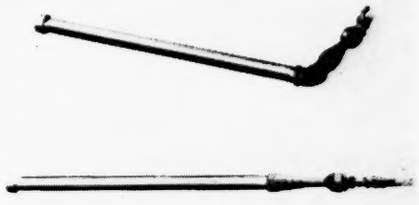
NAME—Far-Air rotary cooler.
PURPOSE—For general evaporative cooler use.
FEATURES—Rotor is made of 14



mesh bronze screen spirally wound on a brass drum. Layers of angularly corrugated screen are separated by a layer of flat screen. Everdur reinforcing rods, formed in star shape, are soldered to the brass drum. Rotor shaft is of stainless steel. Rotor is driven by a gear motor. Under normal operating conditions, motor draws about 35 watts. Reduction unit is designed to operate continuously at three times its normal load. Shear pins are used in the rotor half of the flexible coupling to protect the gears against accidental damage. A copper water tray fits the contour of the housing. Plumbing connections are brass and are fastened to the tray through the housing with locknuts and solder. A large evenly wetted area is continuously exposed to the air flow in a small and compact unit.
LITERATURE AVAILABLE — Bulletin B1100-1.
MADE BY—*Farr Company, Los Angeles, Calif.* **145**

Bryant Pipe Burner

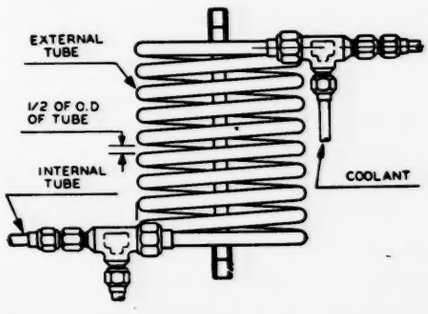
NAME—Bryant industrial type pipe burner.
PURPOSE—Burners to provide efficient combustion for use with natural, manufactured, or liquefied petroleum type of gas.
FEATURES—Burners, it is said, have properly sized and spaced ports for the most efficient combustion and for low turndown without flashback. Burners are provided with Lojector venturi mixers with or without gas cocks. Mixers are of heavy duty construction with integral cast mounting lugs. Orifice spuds may be inspected or changed by using only a screwdriver and pliers. Burners are available with either single-row or double-row port drilling. If desired, a mounted torch pilot or spark plug ignition may be supplied.
SIZES AND CAPACITIES—Line covers ⅜ to 4 in. pipe size with flame lengths from 6 to 132 in. Capacities (Btu per hour) range from 10,000 to 300,000.
LITERATURE AVAILABLE — 8-page data sheet 1A-6 has capacity selection tables for choosing the proper burner.
MADE BY—*Bryant Industrial Div.,*



Affiliated Gas Equipment, Inc., 1020 London Rd., Cleveland 10, Ohio. **146**

Parker Coils

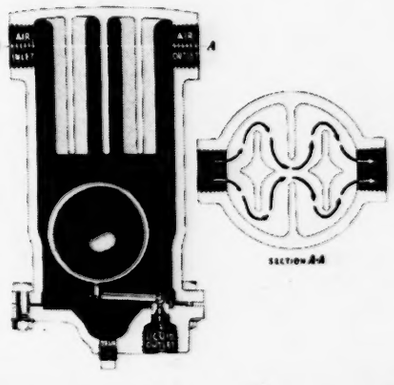
NAME—Parker dual heat transfer coils.
PURPOSE—Stock transfer coils for heat exchange between liquids and gases.
FEATURES—For service at pressures to 1000 lb and temperatures to 700F, units are fabricated of seamless copper tube and bronze fittings. For pressures to 2000 lb and temperatures to 1500F, outer coils are seamless copper while inner coils are stainless steel. In the standard sizes, 19½ ft of tubing are used in the outer coil and 20 ft in the inner coil. Heat transfer area ratios range from 2.62 sq ft for the external coil and 1.41 sq ft internal, to 7.85 sq ft external and 5.81 sq ft internal.
SIZES AND CAPACITIES—External tube sizes range from ½ to 1½ in. O.D. Internal tubes from ½ to 1 in. Coil O.D. ranges from 5 to 13 in.
MADE BY—*The Parker Appliance*



Co., 17325 Euclid Ave., Cleveland 12, Ohio. **147**

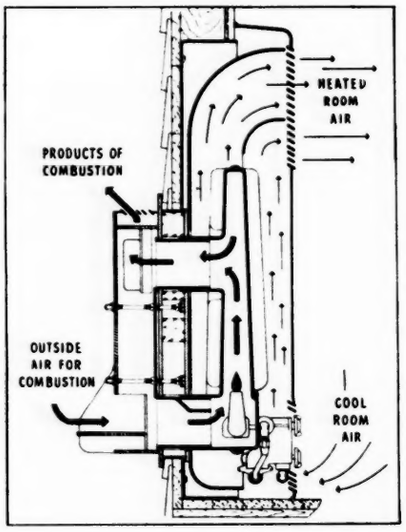
Clark Separator Trap

NAME—Clark series 430 combination separator trap.
PURPOSE — To remove entrained moisture and condensate from air supply lines.
FEATURES—Moisture from the air supply is diverted to a collecting chamber where the integral ball float trap automatically discharges the collected moisture into a drain. Pressure drop through the separator is said to be negligible. While designed primarily for air line service, makers claim trap can also be used as effectively on steam or gas lines.
SIZES AND CAPACITIES—½, ¾, 1, 1¼, and 1½ in. The ½ and ¾-in. sizes are suitable for pressures up to 150 lb per sq in. and the other sizes for pressures up to 200 lb per sq in.
MADE BY—*The Clark Manufacturing Co., 1830 E. 38th St., Cleveland 14, Ohio.* **148**



Saf-Aire Wall Furnace

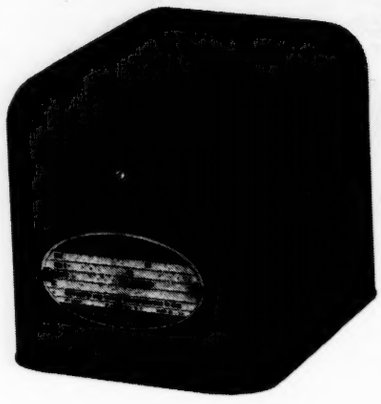
NAME — Saf-Aire wall furnace, model 992-20.
PURPOSE—Gas-fired space heating.
FEATURES—Air is drawn in from outdoors through a specially de-



signed vent and all fumes and odors are exhausted through a wall vent. Combustion products are sealed from contact with room air so that oxygen in the room cannot be exhausted. Heater is designed to fit into an outside wall between studs, and requires only a connection to a gas main. Accessory kits include flue and air intake terminals of lengths to meet construction requirements. It requires only a connection to the utility gas line. Control consists of a pilot, a regulator, and both thermostatic and manual controls. Burner is of the cast iron atmospheric type. Unit is of aluminum construction and extends only 4 in. into the room.
SIZES AND CAPACITIES—Input for natural, manufactured or mixed gases, 20,000 Btu per hr; liquefied petroleum gas, 19,000 Btu per hr. Size, 18 in. wide; 38½ in. high.
LITERATURE AVAILABLE—Circular.
MADE BY—*Stewart-Warner Corp., 1826 Diversey Pkwy., Chicago 14, Ill.* **149**

G-E Ignition Transformer

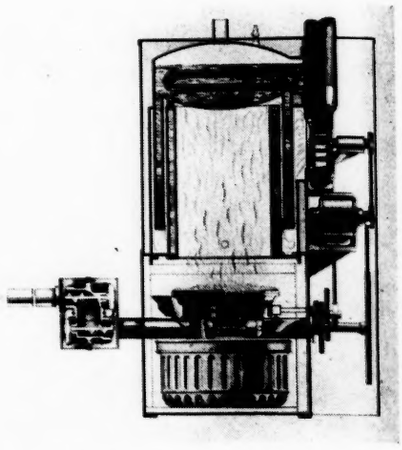
NAME—General Electric SM ignition transformer.
PURPOSE—Ignition transformer designed for use with oil burners.
FEATURES — Transformer is built complete with built-in, two-way self-shielding for radio-interference suppression. High voltage bushings and low voltage junction boxes are located at the same end of the transformer to permit easy access to the unit for maintenance purposes. A steel junction box partition provides protection of the low voltage coils. Line consists of four standardized ignition transformers assembled in two case sizes, medium and small. The domestic type has primary voltage of 100 to 120 volts and secondary voltage of 10,000 volts.
LITERATURE AVAILABLE—Folder.



MADE BY — *General Electric Co., Schenectady, N. Y.* **150**

Unimatic Stoker-Boiler

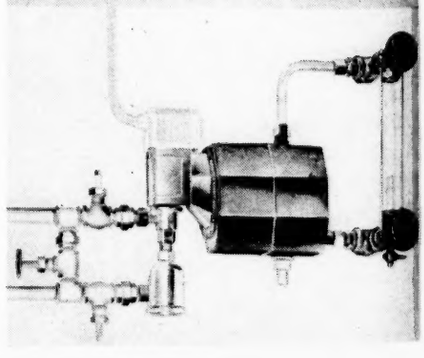
NAME—Unimatic.
PURPOSE—Packaged unit stoker for boiler and domestic hot water installations.
FEATURES—Induced draft operation is said to prevent dust, gases, and ashes from escaping, and to provide for quiet operation. Ashes are cleared from the revolving retort and diverted into a large ash container enclosed in the sealed base. Universal bin feed permits the unit to be placed in the most suitable location. Stoker is delivered with all controls wired for operation, thereby simplifying installation to piping, power wiring, and stack connections. Removal of the rear cover permits access to all controls, motor, fan and gears as all mechanical and combustion parts can be removed easily. Unit features vertical construction, all-steel welded design, stainless steel



worms, full insulation, and complete jacketing.
SIZES AND CAPACITIES — Up to 225,000 Btu per hr.
LITERATURE AVAILABLE—Circular.
MADE BY — *Rogers-Gross, 909 N. 9th St., Philadelphia 23, Pa.* **151**

Water-Boy Control

NAME—577 Water-Boy control.
PURPOSE—Combination feeder and low water cut-off control.
FEATURES—Unit is designed for automatically-fired low pressure steam boilers up to 5000 sq ft capacity carrying a maximum steam pressure of 25 lb. Switch rating is ¾ hp, 110-volt, a-c. Unit comes complete with quick hook-up fittings. Blow-off valve is of the built-in type. Piping to and from the feeder can be carried in any direction desired. Strainer has 10 sq in. of screen area.
LITERATURE AVAILABLE—Circular.
MADE BY—*Maid-O'-Mist, Inc., 3217 N. Pulaski Rd., Chicago 41, Ill.* **152**



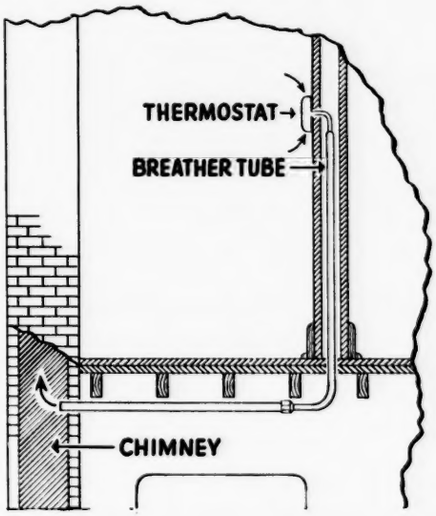
Kenco Sump Pump

NAME—Kenco model P-109 sump pump.
PURPOSE—Submergible sump pump for removing stagnant water from low levels.

FEATURES—The turn-on point at which the pump functions is easily adjustable from a few inches to several feet. Diaphragm switch has no moving parts exposed to water. Pressure of the rising water actuates the switch which is located in the discharge line; subsequent pumping action keeps it in operation. Switch shuts off the pump when the unit draws air. Exposed surfaces are of bronze construction. Ball bearing motor is hermetically sealed and the bearings run in submerged oil. Pump is located directly on the motor shaft to eliminate extra bearings and couplings.
SIZES AND CAPACITIES—Pump is powered by a 1/3-hp, 115-volt, a-c motor and pump is rated at 3300 gph at a 10-ft lift.
MADE BY—*Kenco, Inc., Elyria, Ohio.* **153**

McLarty Compensating Thermostat

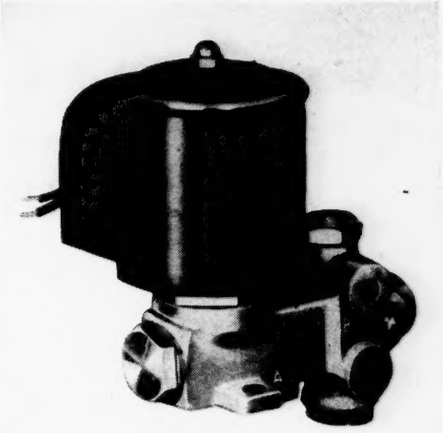
NAME—Breathe-O-Stat.
PURPOSE—To make thermostats automatically compensate for warm, cold, or windy weather.
FEATURES—Unit consists of an anticipation type thermostat and a tube which leads from the thermostat to the chimney flue. This tube causes a draft to flow through the thermostat drawing the air sample directly over the control mechanism. There are no moving parts or electrical connections except those necessary for an ordinary anticipation thermostat. Unit has a differential which permits holding room temperature to within 1½ degrees. During mild weather with a light draft, the heater element in the thermostat is permitted to operate in an almost normal manner but in cold or windy weather the increased draft removes the effect of the thermostat heater by siphoning away the heat, and thus enabling the burner to operate for longer runs. The general pattern with this device is about 3 min on in mild weather, 7 min on in average winter weather, and up to 15 min on in very cold windy weather. Once the unit has been installed, it is said to operate efficiently as long as the system remains unaltered.



MADE BY—*McLarty Systems, 205 W. Michigan Ave., Battle Creek, Mich.* **154**

Asco Solenoid Valve

NAME—Asco steam service 3-way solenoid valve.
PURPOSE—Packless solenoid valve for handling steam up to 250 lb pressure, 450F.
FEATURES—Valve is operated directly by a solenoid through a power-multiplying internal lever. Solenoid is protected with brazed core tube joints to insure the necessary seal for steam service. Coils are either of a high temperature glass insulated winding or silicon winding constructed for continuous duty service. Valves are supplied with cast bronze bodies, although cast iron bodies are available. Valve seats, discs, and springs are of stainless steel and are operated by a stainless steel internal lever.



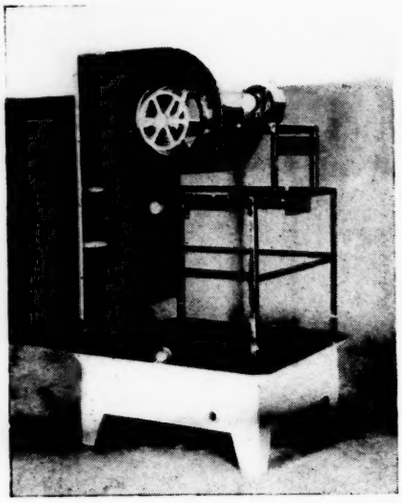
Available with standard Nema Type 1 solenoid enclosure, explosion-proof solenoid, or watertight solenoid housing.
SIZES AND CAPACITIES—For pipe sizes ⅛, ¼, ⅜ and ½ in., and port sizes, 3/16, ¼, 5/16 and ⅜ in.
MADE BY—*Automatic Switch Co., Orange, N. J.* **155**

Stainless Steel Coating

NAME—Liquid stainless steel.
PURPOSE—For applying a coating of stainless steel .001 in. thick or more, to any surface.
FEATURES—Stainless steel of 18-8, type 302, is reduced to fine leaf-like flakes which is then combined with vinyl copolymer and a volatile thinner to bring it to brushing consistency. This makes it possible to apply the metal as a brush coat to all surfaces as a protection against moisture penetration or oxidation. Coating is said to be non-oxidizing and unaffected by age. Paint does not require a primer unless a primer is indicated for other reasons. Makers claim that this coating inhibits electrolysis and that it does not create any electrolytic action of its own. One gallon is said to cover from 500 to 600 sq ft of surface. It dries hard in one hour.
MADE BY—*The Lockrey Co., College Point, N. Y.* **156**

Acme Cooling Tower

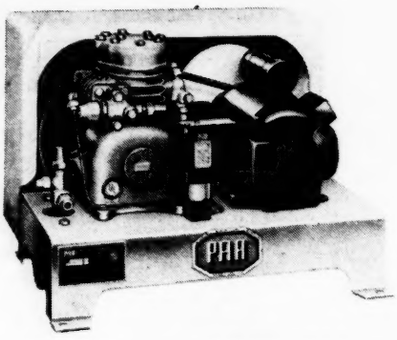
NAME—Acme cooling tower.
PURPOSE — To provide a compact



tower of all steel construction for cooling condenser water.
FEATURES—Fan housing is adjustable on the job for either vertical or horizontal discharge. Manifold connections are provided on all four sides of the unit. Fan is of the squirrel-cage type, with shaft mounted on sleeve bearings, and powered by a ¼-hp motor. Air velocity through the unit is approximately 2000 cfm. Air and water travel in counter flow directions. Water manifold connection is provided on all four sides so the unit may be installed in any corner. Fiber glass is used as a filtering medium. The 5-ton unit illustrated occupies a space of only 35 x 35 x 69 in. Unit may be installed indoors or outdoors.
SIZES AND CAPACITIES — Available in 3-, 5-, 7½- and 10-ton sizes.
LITERATURE AVAILABLE—Folder.
MADE BY—*Acme Equipment Co., Muskogee, Okla.* **157**

Par Condensing Unit

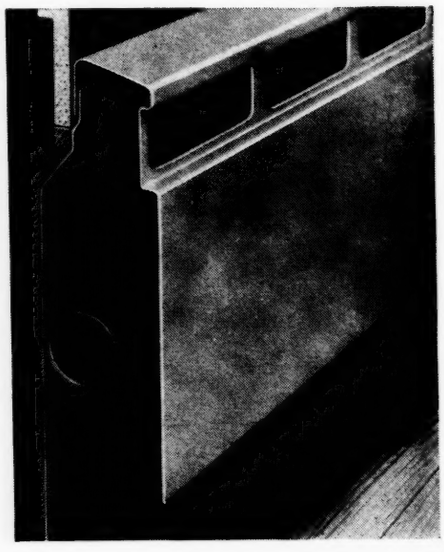
NAME—Par condensing unit.
PURPOSE—For either self-contained or remote cooling applications.
FEATURES—Compressor is designed for slow speed operation and is provided with an oversize condenser. It has interlocked eccentric and flywheel which can be run in either direction. A built-in oil separator prevents circulation of excessive oil and liquid slugging. A screen strainer prevents foreign matter from entering compressor valves. Suction and discharge line valves are mounted on the body and the head can be readily removed. Refrigerant is F-12 or, when specified, methyl chloride. Compressor has two cylinders with a displacement of 74.3 and 97.4 cu ft per hr when operating, respectively, at 439 and 576 rpm.
SIZES AND CAPACITIES—Model RA-2, ¼ hp and RA-3, 1/3 hp.
LITERATURE AVAILABLE—Illustrated folder.
MADE BY—*Lynch Corporation, Par*



Compressor Division, Toledo 1, Ohio. **158**

Vulcan Baseboard Cover

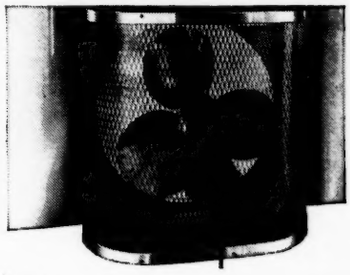
NAME—Front cover for Vulcan residential baseboard radiation.
PURPOSE—Baseboard radiation cover.
FEATURES—Front cover, style FS, is made with a slotted opening in-



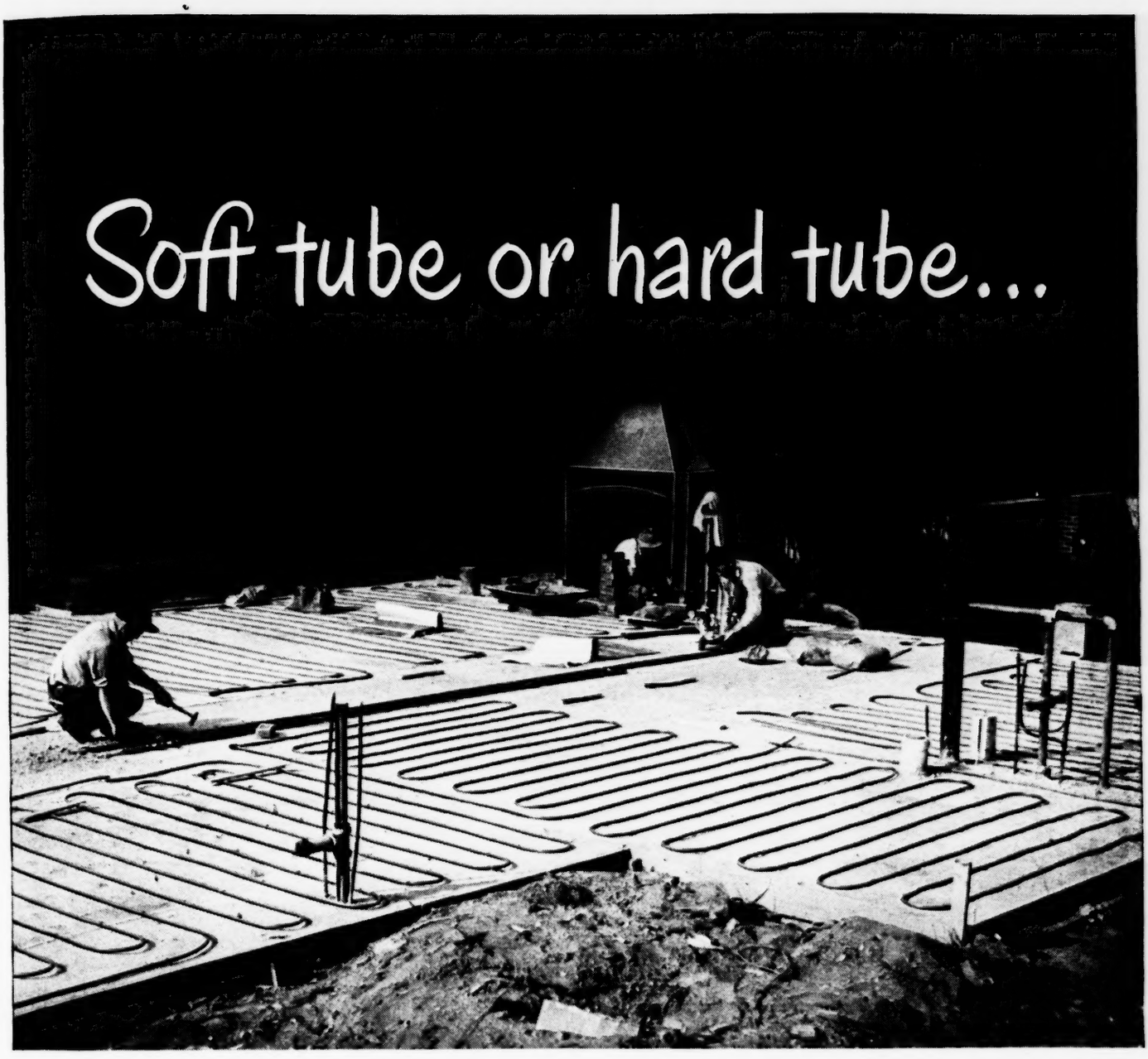
set in the front of the cover to be used with the company's type baseboard radiation. The cover is made of 18-gage steel and can be furnished for both 1 and 1¼ in. IPS Vulcan fin type radiation in semi-recessed or non-recessed installations. Since the method of hanging is the same it can be used to replace the standard style cover. While the maximum length in one piece is 8 ft, shorter lengths can be supplied only in multiples of 4 in. Corner pieces, joining pieces, and closed ends are also available.
MADE BY—*Vulcan Radiator Co., Hartford, Conn.* **159**

Baldor Window Fan

NAME—Baldor Wind-O-Fan, model W20.
PURPOSE—For ventilating homes, offices and shops.



FEATURES—Unit is recommended for homes and apartments of six rooms or less and for similar space requirements. Window fan is mounted in a wooden frame and is equipped with a 20-in. fan blade. Fan is driven by a 1/6-hp, two-speed motor operating at 1100 and 800 rpm. Sealed type ball bearings are used. Fan is electrically reversible and may be used to exhaust air or draw air into the building. The motor has two forward speeds and two reverse speeds. Unit may be set on the window sill and held in place with hook and eye in the same manner as a screen, or it may be attached with wood screws. Installation of the unit does not disturb the screen in the window or the operation of the window.
LITERATURE AVAILABLE — Bulletin No. 344.
MADE BY—*Baldor Electric Co., 4351 Duncan Ave., St. Louis 10, Mo.* **160**



. . . *always* Revere Copper Water Tube

● On every heating and plumbing job—whether it calls for hard temper or soft temper tube, or both—*trouble always costs more than Revere Copper Water Tube!*

Revere hard temper tube is furnished in straight lengths of 12 feet and 20 feet. Revere soft temper tube is available in straight lengths or coils. It is readily bent either by hand or by machine.

All Revere Copper Water Tube is stamped at regular intervals with the Revere name and the type. These marks are more than identification—they are your assurance of full wall thickness and the close dimensional tolerances so essential for tight soldered joints.

It will also pay you to install such other long-lived Revere materials as Red-Brass Pipe; Sheet Copper and Herculoy for tanks, ducts, pans and trays; Dryseal Copper Refrigeration Tube (dehydrated and sealed); Copper oil burner, heat control and capillary tubes.

Revere materials are handled by Revere Distributors in all parts of the country. The Revere Technical Advisory Service is always ready to serve you. Call your Revere Distributor.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

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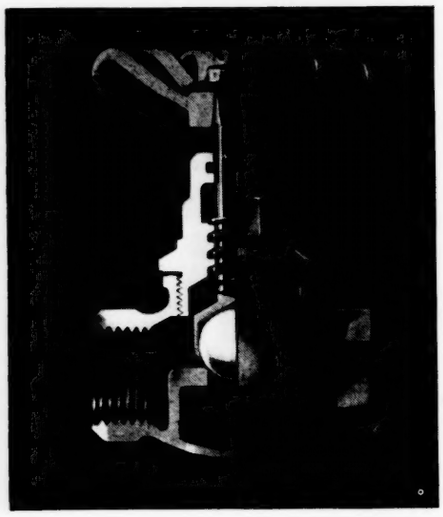
Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.

Sales Offices in Principal Cities, Distributors Everywhere.

Bull-Dog Ball Valve

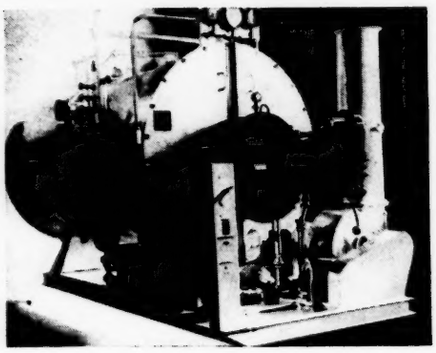
NAME—Bull-Dog ball valve.
PURPOSE—Precision ground stainless steel ball to replace discs and



poppets, in effecting a lifetime seating member for valves.
FEATURES—Ball is spun into its retainer by allowing a slight clearance so that the ball is free to spin when the valve is opened or closed. This enables the ball to seat on a new surface each time the valve is opened or closed. Ball clearance is held to close limits to prevent chatter when the valve is opened, closed, or throttled. Valve is supplied with "0" ring seals for normal service where a high temperature is not involved. Conventional steam packing is used in valves installed in steam or other high temperature service.
SIZES AND CAPACITIES—Available in brass in ½ and ¾ in. pipe sizes.
MADE BY—*Carpenter Manufacturing Corp., 9523 Detroit Ave., Cleveland 2, Ohio.* **161**

Preferred Steam Generator

NAME—Preferred unit combination packaged steam generator.
PURPOSE—Rapid change-over from oil to gas in units employing a horizontal rotary oil burner.
FEATURES—Oil burner is swung open and the primary gas burner is inserted in the normal oil burning firing port. The primary gas burner is adjusted to handle 25 to 30% of the total maximum heat input and is supplemented by a main gas burner in the form of an annular ring which is always



in place inside the furnace extension. Since the jets of the main burner handle the balance of the total heat input, the arrangement of a primary and secondary gas burner is said to utilize the full cross-sectional area of the combustion chamber. The steam generators provide fully automatic operation from high to low fire with all grades of commercial gas and oils including Bunker C and No. 6 oil. Another combination gas and oil unit is available for use with pressure atomizing type burner units.
MADE BY — *Preferred Utilities Mfg. Corp., 1860 Broadway, New York 23, N. Y.* **162**

Cramer Drafting Chair

NAME — Cramer drafting chair, model 2422-TR.
PURPOSE — Posture-type chair for use in drafting room.
FEATURES—Height of seat may be adjusted from 23½ in. to 32½ in. A handwheel provides adjustment of depth of seat. A similar adjustment is used to vary the height of the back for posturized comfort. The footrest is independent of the height adjustment. Seat is provided with a forward-tilting mechanism which may be adjusted for the degree of tilt and the weight of the user. As the draftsman leans forward this device permits the seat and back to follow his motions.

Because of the wide span of chair legs, it is possible to use casters without fear of overturning the chair.
MADE BY — *Cramer Posture Chair Co., Inc., 1205 Charlotte St., Kansas City 6, Mo.* **163**

APRIL, 1949

TO OBTAIN FURTHER INFORMATION ON NEW EQUIPMENT

On the list below, circle the item number of the equipment in which you are interested, using the number found at the end of each item.

119	120	121	122	123	124	125	126	127
128	129	130	131	132	133	134	135	136
137	138	139	140	141	142	143	144	145
146	147	148	149	150	151	152	153	154
155	156	157	158	159	160	161	162	163

Print your name and address, detach and mail to
Editor, HEATING AND VENTILATING, 148 Lafayette St., New York 13, N. Y.

Name .....

Title (Must be shown) .....

Firm (Must be shown) .....
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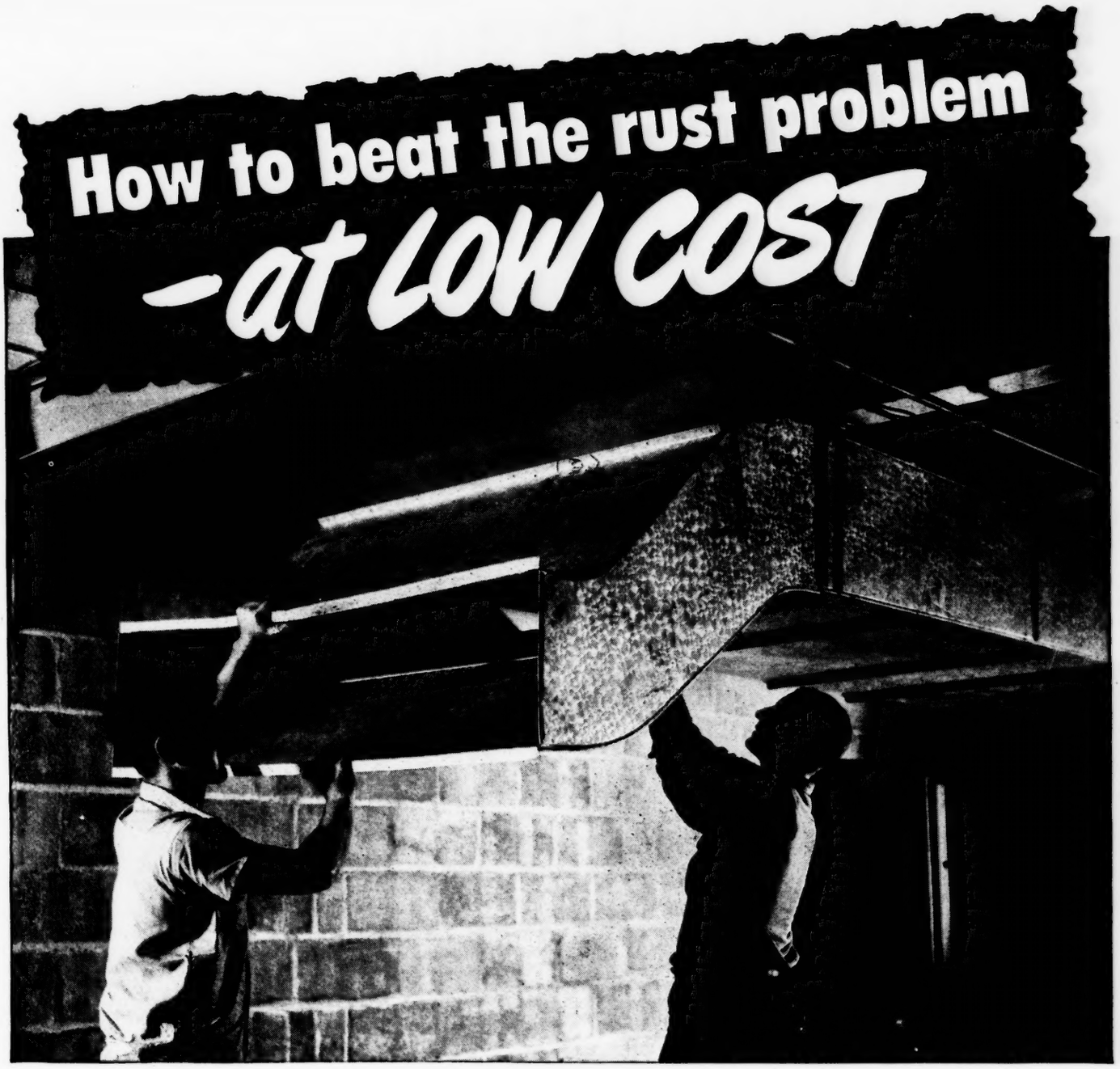
City .....**Zone**....**State**.....**4/49**

How to beat the rust problem —at LOW COST



There is more than one answer to the problem of corrosion in ductwork. But considering cost of materials and their workability, there is a practical solution in the use of a rust-defying, copper-bearing galvanized sheet steel like Beth-Cu-Loy.

Beth-Cu-Loy Sheets offer a double defense against rust. Beth-Cu-Loy is protected on the surface by Prime Western zinc applied in a tight, bright coating. Under the coating is the Beth-Cu-Loy base containing 0.20 to 0.30 percent copper, with 2 to 2½ times the rust-resistance of ordinary steel. Result: if rust eventually penetrates the zinc coating, it comes up against a barrier of copper-bearing steel.

Beth-Cu-Loy sheets have the easy-forming qualities that sheet-metal men like, yet they have adequate stiffness to permit the use of long sections in ductwork. They are simple to cut, to seam and to solder. With all of these advantages, Beth-Cu-Loy Galvanized Sheets cost very little more than ordinary zinc-coated steel sheets.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem Products are sold by Bethlehem Pacific Coast Steel Corporation

Beth-Cu-Loy Galvanized Sheets

BETHLEHEM STEEL

DEGREE-DAYS FOR FEBRUARY, 1949

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

HEATING AND VENTILATING's 21st Year of Publication of Monthly Degree-Day Data

City	February			Cumulative, Sept. 1 to Feb. 28			Heating Season[1]
	1949	1948	Normal	1948-49	1947-48	Normal	Normal
Abilene, Texas (A)	463	583	510	2331	2391	1761	2061
Albany, New York (A)	999	1355	1142	4472	5536	4868	6580
Albuquerque, New Mexico (A)	777	791	692	3745	3609	3443	4298
Alpena, Michigan (C)	1125	1356	1278	4843	5506	5660	8299*
Anaconda, Montana (C)	1219	1270	1164	6556	5750	5656	8357**
Asheville, North Carolina (C)	517	598	756	2569	3180	3276	4232
Atlanta, Georgia (A)	378	493	557	1798	2453	2370	2890
Atlantic City, New Jersey (C)	672	885	904	2834	3647	3631	5176
Augusta, Georgia (C)	250	427	423	1222	2058	1864	2161
Baker, Oregon (C)	1051	1046	991	5995	4673	5024	7163
Baltimore, Maryland (C)	592	820	843	2701	3519	3462	4533
Billings, Montana (A)	1333	1223	1120	5879	5106	5254	7119
Binghamton, New York (C)	904	1206	1182	4161	5029	4965	6808
Birmingham, Alabama (A)	378	459	521	1753	2396	2023	2352
Bismarck, North Dakota (A)	1756	1684	1548	7048	6839	6869	9192
Block Island, Rhode Island (C)	788	1038	983	3240	4068	3767	5788
Boise, Idaho (A)	960	955	848	5266	4313	4230	5552
Boston, Massachusetts (A)	855	1118	1042	3565	4501	4322	6045
Bozeman, Montana (C)	1240	1248	1208	6420	5776	5897	8521**
Buffalo, New York (A)	930	1153	1156	4094	4898	4768	6822
Burlington, Iowa (A)	1112	1144	(a)	4664	4813	(a)	(a)
Burlington, Vermont (A)	1151	1450	1294	4878	5930	5496	7514
Butte, Montana (C)	1326	1333	1143	6966	6177	5635	8235**
Cairo, Illinois (C)	618	762	762	2695	3301	3169	3909
Canton, New York (C)	1155	1444	1328	4989	6044	5842	8020
Charleston, South Carolina (C)	196	415	372	843	1721	1491	1769
Charlotte, North Carolina (C)	390	593	588	1837	2731	2533	3120
Chattanooga, Tennessee (A)	454	533	602	2195	2780	2559	3118
Cheyenne, Wyoming (A)	1108	1190	1075	5624	5223	5179	7466
Chicago, Illinois (C)	987	1050	1039	4035	4516	4401	6077
Cincinnati, Ohio (C)	660	822	862	2993	3701	3675	4684
Cleveland, Ohio (A)	862	1056	1075	3846	4571	4441	6155
Columbia, Missouri (C)	856	940	897	3714	3846	3903	4922
Columbia, South Carolina (C)	268	487	498	1311	2206	2000	2364
Columbus, Ohio (C)	758	939	980	3433	4179	4113	5398
Concord, New Hampshire (A)	1065	1410	1240	4753	5804	5321	7353
Concordia, Kansas (C)	1054	1070	970	4535	4260	4173	5315
Dallas, Texas (A)	465	534	493	2077	2277	1980	2256
Davenport, Iowa (C)	1085	1127	1140	4519	4775	4825	6289
Dayton, Ohio (A)	830	1017	980	3793	4518	4043	5264
Deer Lodge, Montana (C)	1281	1231	1175	6897	5704	6069	8672**
Denver, Colorado (C)	879	1012	918	4501	4246	4273	5874
Des Moines, Iowa (C)	1229	1183	1173	4900	4840	4935	6384
Detroit, Michigan (A)	962	1178	1134	4145	4866	4718	6490
Devils Lake, North Dakota (C)	1861	1772	1551	7475	7411	7371	9970
Dodge City, Kansas (A)	921	1031	890	4299	4133	3958	5035
Dubuque, Iowa (C)	1197	1215	1218	4926	5143	5194	6790
Duluth, Minnesota (C)	1514	1566	1464	6220	6858	6680	9483
Eastport, Maine (C)	1110	1364	1232	4844	5473	5502	8520**
Elkins, West Virginia (A)	782	884	991	3709	4412	4256	5697
El Paso, Texas (A)	473	471	434	2521	2417	2101	2428
Ely, Nevada (A)	1398	1187	(a)	6574	5375	(a)	(a)
Erie, Pennsylvania (C)	846	1064	1098	3677	4426	4434	6273
Escanaba, Michigan (C)	1281	1418	1340	5343	5882	6028	8771
Evansville, Indiana (A)	731	869	854	3181	3833	3348	4244
Fort Smith, Arkansas (A)	561	658	630	2655	2851	2657	3147
Fort Wayne, Indiana (A)	918	1115	1098	4168	4875	4503	5925
Fort Worth, Texas (A)	457	519	498	2059	2279	1904	2148
Fresno, California (A)	499	463	389	2367	2001	1883	2334
Galveston, Texas (C)	185	314	255	822	1262	938	1016
Grand Junction, Colorado (A)	1252	1011	863	5142	4596	4374	5548
Grand Rapids, Michigan (C)	1005	1157	1204	4261	4807	4863	6535
Green Bay, Wisconsin (C)	1306	1398	1358	5349	5849	5778	7825
Greensboro, North Carolina (A)	495	688	678	2426	3219	2845	3529
Greenville, South Carolina (A)	422	558	661	1980	2702	2739	3380
Harrisburg, Pennsylvania (A)	776	1011	1008	3557	4265	4077	5375
Hartford, Connecticut (A)	897	1214	1100	3930	4919	4416	6036
Hatteras, North Carolina (C)	319	492	535	1328	1984	1851	2571
Havre, Montana (C)	1612	1421	1450	6852	5638	6388	8700
Helena, Montana (A)	1412	1290	1178	6869	5614	5611	7894**
Houston, Texas (C)	188	305	277	997	1358	1092	1157
Huron, South Dakota (A)	1492	1496	1340	6225	6319	6075	8004
Indianapolis, Indiana (A)	838	940	969	3832	4185	4099	5298
Jackson, Mississippi (A)	315	413	(a)	1435	2017	(a)	(a)
Kansas City, Missouri (A)	913	986	946	3848	3946	3953	4956
Knoxville, Tennessee (A)	486	594	666	2356	2937	2964	3670
La Crosse, Wisconsin (A)	1378	1377	1265	5610	6006	5578	7322
Lander, Wyoming (A)	1308	1305	1155	6520	5508	5666	7947

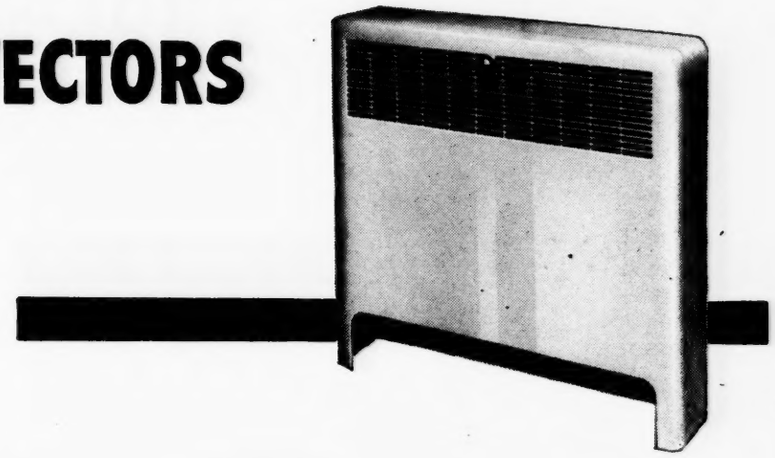
(a) Data not available.

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

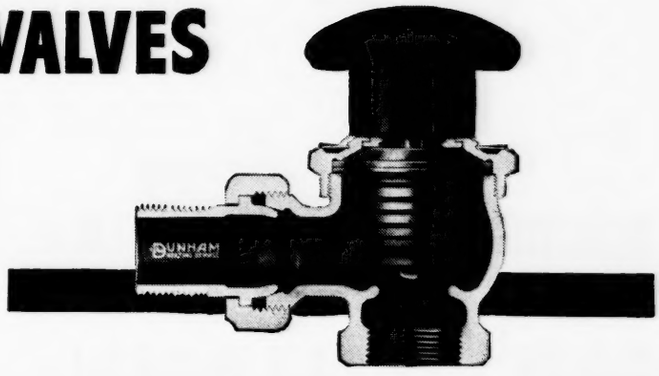
Figures in this table, with seven exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston Me., respectively; Anaconda, Bozeman, Butte, Deer Lodge and Livingston, Mont., through the courtesy of the Montana Power Company.

[Table concluded on page 114]

From CABINET CONVECTORS



To PACKLESS VALVES



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HEATING MEANS BETTER HEATING

Degree-Days for February, 1949 (Concluded)

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

HEATING AND VENTILATING's 21st Year of Publication of Monthly Degree-Day Data

City	February			Cumulative, Sept. 1 to Feb. 28			Heating Season[1]
	1949	1948	Normal	1948-49	1947-48	Normal	Normal
Lansing, Michigan (A)	1056	1220	1201	4570	5235	5202	7048
Lewiston, Maine (O)	1108	1386	1243	4686	5610	5532	7707
Lincoln, Nebraska (C)	1189	1145	1131	4975	4673	4643	5999
Little Rock, Arkansas (A)	476	658	582	2284	2724	2380	2811
Livingston, Montana (C)	1160	1192	1067	5686	5220	5018	7245**
Los Angeles, California (C)	348	308	266	1420	984	1016	1504
Louisville, Kentucky (A)	662	810	801	2976	3560	3327	4180
Lynchburg, Virginia (A)	550	746	730	2708	3473	3143	3980
Macon, Georgia (C)	270	407	462	1354	2077	1908	2201
Madison, Wisconsin (C)	1250	1321	1299	5108	5612	5557	7429
Marquette, Michigan (C)	1302	1579	1361	4079	4488	5915	8693*
Memphis, Tennessee (A)	489	659	599	2259	2839	2470	2950
Meridian, Mississippi (C)	319	412	456	1425	2057	1891	2160
Milwaukee, Wisconsin (A)	1158	1184	1201	4767	5231	5185	7245
Minneapolis, Minnesota (A)	1449	1430	1400	5807	6158	5950	7850
Montgomery, Alabama (C)	237	325	392	1151	1797	1676	1884
Nantucket, Massachusetts (A)	832	1037	974	3518	4261	3912	5957
Nashville, Tennessee (A)	561	667	675	2460	3106	2850	3507
New Haven, Connecticut (A)	844	1148	1011	3653	4611	4230	5895
New Orleans, Louisiana (C)	120	235	230	719	1253	965	1024
New York, New York (C)	731	970	953	3043	3985	3837	5274***
Nome, Alaska† (A)	(a)	1953	1660	(a)	7145	8886	14580**
Norfolk, Virginia (C)	420	638	650	1845	2679	2583	3350
North Head, Washington (C)	684	682	622	3576	3002	3132	5452**
North Platte, Nebraska (C)	1127	1072	1020	5276	4621	4806	6366
Oakland, California (A)	523	492	403	2482	2076	2029	3143**
Oklahoma City, Oklahoma (C)	681	773	742	3020	3082	2986	3613
Omaha, Nebraska (A)	1247	1154	1126	5021	4808	4765	6131
Oswego, New York (C)	965	1231	1162	4237	5018	4933	7088
Parkersburg, W. Virginia (C)	659	819	879	3141	3850	3701	4775
Peoria, Illinois (A)	1050	1087	1067	4382	4645	4673	6109
Philadelphia, Pennsylvania (C)	675	914	881	2900	3771	3542	4737***
Phoenix, Arizona (C)	341	322	263	1634	1377	1253	1405
Pittsburgh, Pennsylvania (C)	704	881	944	3254	4259	3947	5235
Pocatello, Idaho (A)	1099	1030	986	5912	4989	4853	6655
Portland, Maine (A)	1085	1355	1162	4725	5438	5088	7218
Portland, Oregon (C)	662	655	644	3544	2842	3174	4469
Providence, Rhode Island (C)	801	1092	1070	3451	4394	4316	6015
Pueblo, Colorado (A)	891	1105	916	4552	4505	4140	5514
Raleigh, North Carolina (C)	420	640	630	1935	2863	2605	3234
Rapid City, South Dakota (A)	1329	1271	1119	5818	5154	5140	7118
Reading, Pennsylvania (C)	747	982	980	3282	4096	4082	5389
Red Bluff, California (A)	547	518	(a)	2494	2115	(a)	(a)
Reno, Nevada (A)	976	943	823	5134	4290	4149	5892
Richmond, Virginia (C)	487	697	695	2320	3202	2906	3695
Rochester, New York (A)	960	1213	1159	4262	5045	4825	6732
Roseburg, Oregon (C)	(a)	654	605	(a)	2953	3090	4428
Roswell, New Mexico (A)	612	690	580	3257	3207	2876	3484
Sacramento, California (C)	514	488	426	2448	2088	2036	2653
St. Joseph, Missouri (A)	1050	1074	974	4337	4300	4121	5161
St. Louis, Missouri (C)	782	875	854	3321	3708	3652	4585
Salt Lake City, Utah (A)	1183	920	885	5431	4373	4144	5555
San Antonio, Texas (A)	240	372	274	1400	1605	1128	1202
San Diego, California (A)	344	315	280	1437	1105	1099	1645
Sandusky, Ohio (C)	851	1071	1061	3759	4496	4384	6208
San Francisco, California (C)	466	414	356	2200	1699	1770	3264**
Sault Ste. Marie, Michigan (A)	1301	1484	1487	5691	6287	6315	9285**
Savannah, Georgia (A)	161	330	316	805	1557	1323	1490
Scranton, Pennsylvania (C)	863	1115	1106	3896	4757	4552	6129
Seattle, Washington (C)	704	673	647	3659	3043	3297	4934**
Sheridan, Wyoming (A)	1317	1296	1160	6090	5415	5789	8008
Shreveport, Louisiana (A)	342	488	412	1675	2134	1736	1938
Sioux City, Iowa (A)	1382	1230	1260	5687	5320	5278	6898
Spokane, Washington (A)	1078	1048	952	5870	4812	4707	6355
Springfield, Illinois (C)	899	965	1008	3797	4093	4191	5373
Springfield, Missouri (A)	739	893	876	3471	3701	3523	4428
Syracuse, New York (A)	960	1265	1212	4289	5212	4980	6893
Tacoma, Washington (C)	723	709	675	3896	3304	3438	5181**
Terre Haute, Indiana (A)	822	962	966	3723	4314	3876	4872
Toledo, Ohio (A)	913	1141	1075	4120	4886	4467	6077
Topeka, Kansas (C)	951	1008	935	3980	4020	3953	4969
Trenton, New Jersey (C)	734	983	941	3182	4076	3715	4933
Utica, New York (O)	870	1297	1181	4070	5410	4966	6796
Valentine, Nebraska (C)	1240	1214	1130	5740	5209	5225	7039
Walla Walla, Washington (C)	824	808	778	4487	3578	3676	4808
Washington, D. C. (C)	576	797	848	2707	3504	3559	4626
Wichita, Kansas (A)	899	955	896	3884	3780	3773	4673
Williston, North Dakota (C)	1734	1643	1495	7134	6541	6958	9323
Winnemucca, Nevada (C)	1020	956	905	5448	4502	4644	6427**
Yakima, Washington (A)	989	983	846	5307	4274	4433	5599

(a) Data not available.
†Nome data are for January.

*Includes August.
**Includes July and August.
***New 48-year normal covering 1898 to 1946.

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

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Abstracts AND Reviews

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NDHA PROCEEDINGS

Papers presented at the thirty-ninth annual meeting of the National District Heating Association convention held in the Hotel Statler, St. Louis, Mo., May 18-21, 1948, are contained in the Proceedings of the National District Heating Association. This volume also contains the official proceedings of the convention, discussion of the papers, financial statement of the association, and the list of members.

Proceedings of the National District Heating Association. Cloth bound, 6 x 9 in., 314 pages. Published by the National District Heating Association, 827 N. Euclid Ave., Pittsburgh 6, Pa. Price, $5.

VIBRATION

Methods of solution to enable the engineer to solve problems in the field of vibration by methods that do not require training in advanced mathematics were described by C. R. Freberg, Head, Engineering Research Division, Southern Research Institute, and Dr. E. N. Kemler, Research Professor of Mechanical Engineering, New York University, in their first edition of Elements of Mechanical Vibration.

The second edition of this book is now available. A number of changes have been made in the text of the first edition to clarify some of the data and new material has been added to some of the later chapters. In addition, a chapter has been added on sound and its engineering applications, and one on beams. Errors that appear in the first edition have been corrected in the second edition.

Material covered includes vibrations without damping, damped vibrations, vibration of systems with several degrees of freedom, vibration isolation and absorption, equivalent systems, beams, sound, the mobility method, and mechanical and electrical models of vibration systems.

Elements of Mechanical Vibration, by C. R. Freberg and Emory N. Kemler. Cloth bound, 6 x 9 in., 227 pages. Published by John Wiley & Sons, Inc., 440 4th Ave., New York 16, N. Y. Price, $3.75.

• • •

INDUSTRIAL HEALTH DEPARTMENT—A factual study of industry's existing health facilities, procedures and policies for conserving human resources is contained in a booklet, Industrial Health Department Functions and Relationships. It represents a two-year survey embracing 277 plants in 33 states. Approximately 54% of the plants studied had industrial hygiene services in some form. The survey is divided into the following subjects: General fundamentals, personnel, physical set-up of department, cost of services, functions, intramural and extramural relationships, opinions on justifications for services, public utilities, and comparisons with other studies. Paper bound, 98 pages. Price, $2. Industrial Hygiene Foundation, 4400 5th Ave., Pittsburgh, Pa.

PHYSICAL PROPORTIONS OF COMMERCIAL FANS—As a service to engineers, the National Association of Fan Manufacturers offers a 4-page folder of tables of fan sizes. They represent a general comparison of physical proportions of commercial fans manufactured by member companies. For NAFM Form X-12, write to National Association of Fan Manufacturers, 5-157 General Motors Bldg., Detroit 2, Mich.

PIPE INSULATION FOR HEATED INDUSTRIAL EQUIPMENT—Standard CS117-44 on A Recommended Revision of Mineral Wool: Blankets, Blocks, Insulating Cement, and Pipe Insulation for Heated Industrial Equipment has been submitted to manufacturers and other interested groups for consideration by the Commodity Standards Division of the National Bureau of Standards. Major changes in the recommended revision are the inclusion of requirements for loose, granulated, and felted forms of mineral wool. Commodity Standards Division, National Bureau of Standards, Washington 25, D. C.

ICED VENTILATING SYSTEM—The Bureau of Engineering Research, University of Texas, has developed a unit ice-evaporative cooling fan ventilating system that can be installed in four and five-room houses by ice companies. A report of the development work and the test results obtained are contained in the University of Texas Publication No. 4813, "Intermittent Service, Iced Ventilating System," by James D. McFarland, Harold A. Tankersley and Willis R. Woolrich, all of the Bureau of Engineering Research. It gives detailed information on the construction of the test ventilating system. According to the report, the initial costs were found to be low as compared with compressor type units and satisfactory comfort standards were provided for all weather conditions in the region tested. Bureau of Engineering Research, The University of Texas, Austin, Tex.

MANOMETER TABLES — A tentative recommended practice toward a goal of uniformity in the field of instrumentation is made available in the paper bound booklet which presents fundamental conversion factors commonly used in manometry, recommended definitions of pressure, tables of pressure, etc. Data in the book were arranged with the object of facilitating and standardizing the use of manometers and U tubes as direct pressure indicating instruments or in the calibration of pressure recorders and controllers. To non-members, price $2, to members, $1. Instrument Society of America, Pittsburgh 12, Pa.

(Concluded on page 132)

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NEWS OF THE MONTH

SOLAR HOUSE

erected in Cambridge to use sun's heat entirely, if possible.

A new four-room solar house in Cambridge, Mass., was opened in February and will be occupied by a student family while Massachusetts Institute of Technology engineers study the efficiency of their latest design for using heat from the sun to warm a New England house throughout the winter. This house is somewhat different in heat collecting principle and is a separate project from M.I.T.'s solar house using chemical collectors now under study by Dr. Maria Telkes (H&V:5:47:p.68).

• **HOW MUCH HEAT.**—According to Professor Hoyt C. Hottel of the M.I.T. department of chemical engineering, the house will be used for studies to determine to what degree the sun can compete with conventional methods of heating. "It is not now presumed," he says, "that solar heating will be economically feasible in a climate as cold as that of New England, but the results should serve to indicate under what conditions of climate solar heating is competitive with fuel oil, gas, or coal."

In appearance a typical modern-style residence except for its heat collector in the roof, the new M.I.T. solar house has two bedrooms, kitchen, living-dining room, and instrument room in which M.I.T. engineers will measure the heat absorbed from the sun and that lost from the house during sunless hours.

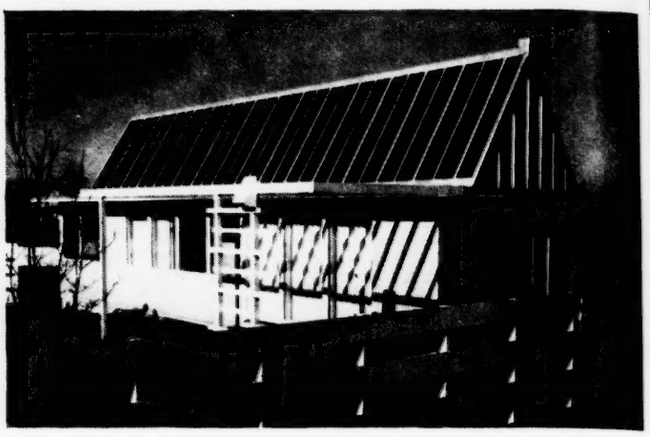
• **EQUIPMENT.**—The heat-storing equipment is designed to keep the house at 68F night and day, but supplementary electric heating units have been provided for long periods of extremely cold weather without sun. They will go into operation should the house temperature drop to 65F. Electric auxiliary heating was chosen primarily because of convenience in experimental work, according to Professor Hottel.

Water, warmed by the sun in a special "flat plate" collector located on the roof of the house, is used for storing and distributing heat. Once warmed by the sun, the water is pumped into an insulated tank in which it is held for use during sunless hours, when the heat is radiated from a panel in the ceiling.

• **FLYWHEEL.**—According to M.I.T. engineers, the storage tank holds 1200 gallons of water which should, during an average January day, rise in temperature a few degrees more than it falls at night, thereby slowly storing heat energy for use on sunless days. Present calculations indicate that this water should have sufficient heat energy capacity to maintain comfortable temperatures in the house for two sunless days of normal January temperature.

From a solar engineer's point of view, a truly sunless day is unusual in New England. Even through light clouds considerable solar heat is received.

The roof heat collector unit, adapted from a unit studied in M.I.T.'s prewar solar heating research pro-



M.I.T.'s solar house.

gram, slopes 57° to the horizontal, faces south, and presents a net area of 400 sq ft on which the sun's heat is received. The roof of the house is covered with aluminum, and additional solar energy will reach the collector by reflection from the roof. In addition, a large window on the south side of the house, opening into the living room, will collect additional heat during sunlight hours.

• **COLLECTOR.**—The collection and heating unit is a compact, closed-cycle system at atmospheric pressure; no outside air or water is introduced once operation is begun. The parts of the unit include the roof collectors, an attic storage tank, a radiant ceiling panel heating unit, two circulating pumps, and controls. Whenever the sun heats the water in the roof collectors to a temperature above that of the storage tank, a pump circulates the water from tank to roof collectors and back. Whenever the temperature of collector water is below that in the storage tank, the flow of water is cut off and the collector is pumped full of air to prevent freezing damage. Quite independently of this circulating system, whenever the room thermostat calls for heat a second pump circulates water between the storage tank and the radiant ceiling panel.

The new house is carefully insulated in order to reduce heat loss to a minimum. Windows have double panes of glass with air space between, and inside curtains will be drawn over them after dark to provide further insulation. The walls are insulated with four-inch pads of rock wool, celotex, and aluminum foil.

• **SUPPLEMENT.**—Designers of the new M.I.T. house decline to estimate the cost of a solar heating system for the average New England house (or even to say that such a system can be effective in as severe a climate as New England's). They point out that the present design does not include expensive oversize equipment to provide capacity for extreme cold spells and sunless periods of a week or more. Instead auxiliary electric equipment is provided to heat the

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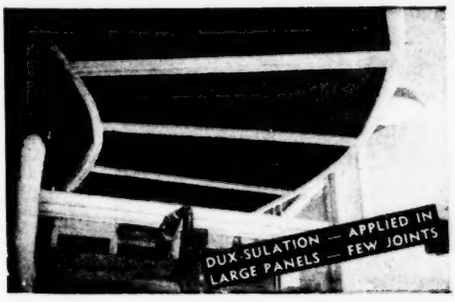

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water in the radiant ceiling panel under these circumstances.

Hot water for domestic use in the solar house is heated independently by a conventional electric unit.

• **RECORDS.**—The instrument room in the house contains automatic recording equipment to measure the intensity of solar radiation, the amount of heat energy received from the sun, the amount supplied in the house by electric means, the temperature of the storage water, and the air temperature at various points in the house. This equipment will make continuous records from which M.I.T. engineers hope to show the source and amount of all heat in the house over a long period of operation.

Since normal family activities will be proceeding in the solar house while tests are being made, M.I.T. scientists hope their automatic instruments will provide figures for heat loss and heat storage requirements under typical dwelling conditions, from which it may eventually be possible to estimate fuel savings and arrive at a practical figure for the over-all costs of solar heating.

• **PEOPLE.**—The house, part of a program of research at M.I.T. into means of utilizing solar energy, was built with funds provided in a grant to the Institute by Godfrey L. Cabot of Boston. The solar energy work is under the supervision of a steering committee consisting of Professor L. B. Anderson, head of the department of architecture; Professor A. G. H. Dietz, department of building engineering and construction; Professor A. L. Hesselschwerdt, Jr., department of mechanical engineering; and Professor H. C. Hottel, department of chemical engineering. The construction of the house and the research directly associated with it are directed by Edmund L. Czapek, research associate in architecture.

The architectural design of the new M.I.T. solar house is the work of J. Frank Haws, Pottstown, Pa., a student in the department of architecture.

COAL-TO-OIL PLANTS

to be dedicated May 8, will test modifications of two German processes.

The Bureau of Mines will dedicate two new coal-to-oil demonstration plants on the anniversary of V-E day, May 8, at Louisiana, Mo., less than 100 miles above St. Louis on the Mississippi River.

First of their kind in this country, these new plants will employ different processes to convert coal and lignite into the high-quality synthetic liquid fuels. They are being erected at a combined cost of $15,000,000 to serve as a proving ground for American coals, equipment, and processing methods. They were authorized by the Synthetic Liquid Fuels Act of 1944.

• **PROCESSES.**—Incorporating numerous innovations, the new synthetic fuel plants will demonstrate the respective merits of two basic processes for converting American coals to oil: (1) The direct hydrogenation or Bergius-I.G. Farben process; and (2) the gas synthesis or indirect Fischer-Tropsch process. These processes are complementary rather than competitive, and the liquid products that each is best adapted to produce range all the way from heavy fuel oils for ships and industry to jet fuels and aviation gasoline.

• **HYDROGENATION.**—The first of the new units—the hydrogenation demonstration plant—now is ready for operation. Production capacity is from 200 to 300 barrels daily, depending on the coal and catalyst used. Built under contract with the Bechtel Corporation of California at a cost of $10,000,000, this plant was designed for pressures up to 10,300 lb per sq in. in two major operations: (1) Liquid-phase hydrogenation, which accomplishes liquefaction of the coal; and (2) vapor-phase hydrogenation, which converts the liquefied coal to gasoline and by-products. Chemically, crude petroleum contains more than twice as much hydrogen than does coal. Thus to convert coal to finished gasoline by this process, hydrogen is added to the coal catalytically under high pressures and temperatures.

Basically, the design of this plant follows that of the German units that supplied virtually all of the aviation gasoline used by the Nazi air force during the war. Many improvements developed in American research laboratories have been incorporated, however. Among these innovations are the use of automatic control instead of hand control to increase capacity and reduce personnel, new and cheaper sources of hydrogen, and a more efficient utilization of heat to lower product costs.

Difficult problems have been encountered and overcome, including the design and fabrication of high pressure equipment new to American manufacturers; development and installation of highly complex instrumentation in order to supply comprehensive information on plant operation to industry, and the training of both engineers and operators in techniques foreign to American industrial experience. German scientific and technical personnel, experienced in all phases of European hydrogenation practice, have been of considerable assistance.

Initially, the plant will process western coals, which lend themselves well to hydrogenation. After the operating difficulties have been ironed out, typical coals from other sections of the country will be tested. Bituminous coals, sub-bituminous coals, and lignites all may be hydrogenated, and the ease of hydrogenation and percentage of conversion increase in the order named. However, the production of one barrel of oil requires only one-half ton of bituminous coal, whereas the requirement for sub-bituminous coal is two-thirds of a ton, and for lignite, one ton.

This process will produce, separately or simultaneously, liquid fuels ranging from high-octane aviation gasoline to Bunker "C" fuel oils with little or no change in the plant. Only the operating conditions need be altered to fill the demand of the moment, which makes such plants of high strategic value from the military viewpoint. By-products will include phenols for plastics, "creosote" for wood preservation, solvents for paints, and hydrocarbon gases for heating fuel.

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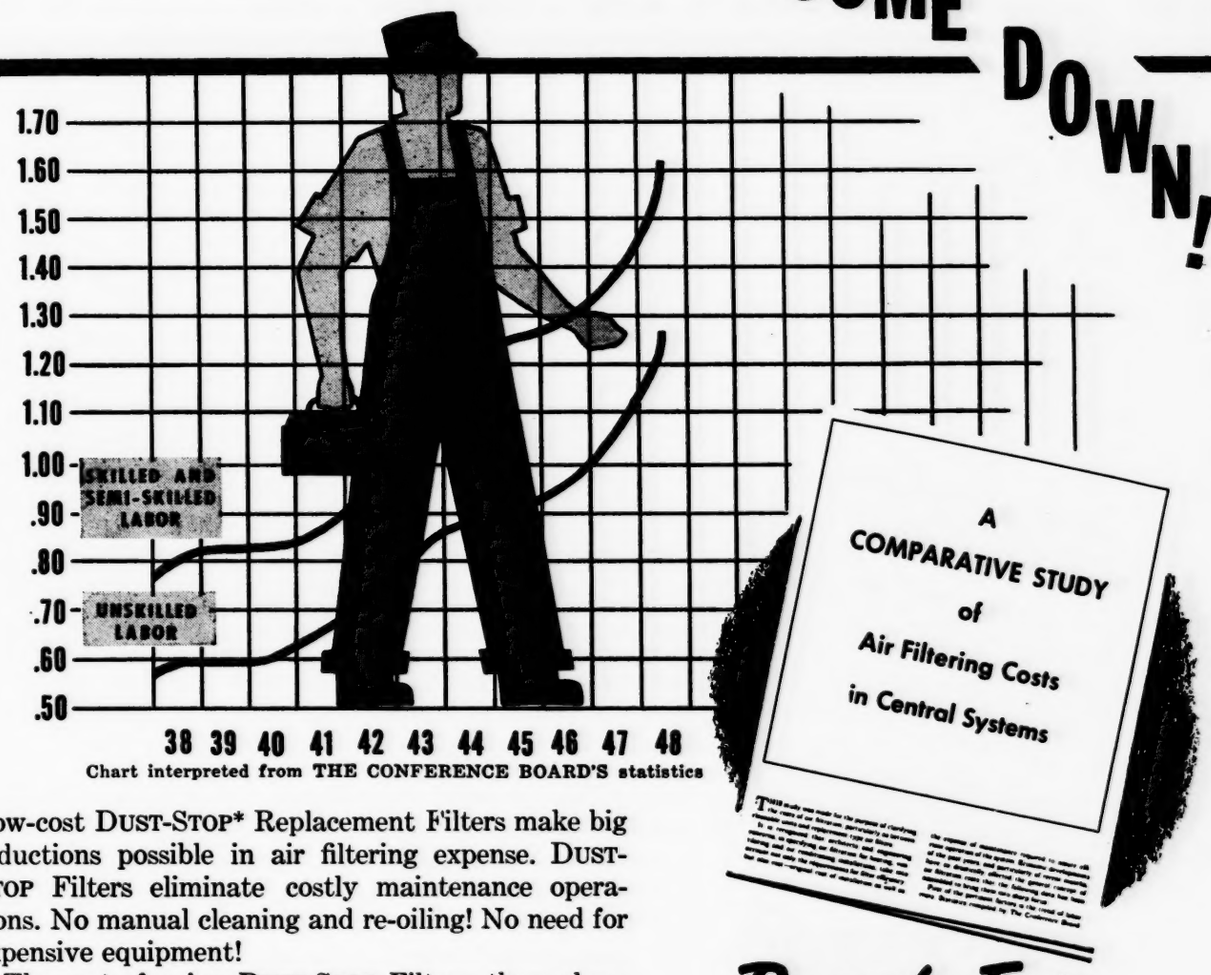

Chart interpreted from THE CONFERENCE BOARD'S statistics

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Based on conditions prevailing in 1948, Bureau engineers estimated that a commercial coal hydrogenation plant with a capacity of 30,000 barrels a day could produce gasoline at a cost of 12 to 15 cents a gallon if no credit is taken for by-products.

• **SYNTHESIS.**—Now under construction, the second of the Bureau's new units—the gas synthesis demonstration plant—is scheduled for completion this year. A contract for its design and construction was awarded to Koppers Co., Inc., of Pittsburgh, Pa., in March, 1948, and the cost is estimated at $5,000,000.

An 80- to 100-barrel-per-day unit, this plant will gasify pulverized coal with oxygen and superheated steam and then convert the resulting synthesis gas—a mixture of carbon monoxide and hydrogen—to liquid fuels by the indirect Fischer-Tropsch process. With American modifications, this process is well adapted to the production of either a good grade of motor gasoline or an excellent Diesel fuel. Product costs are expected to approximate those of the hydrogenation process.

By-products include wax, alcohols, and hydrocarbon gases. Through cracking, the wax can be converted to Diesel fuel and lubricants, or it may be used directly in polishes, insulating materials, and chemicals. The alcohols also are useful in the chemical industries.

In designing and building this plant, too, there is no precedent in American industry, and the solution of many problems can be found only by operation. However, promising advances made in the Bureau's broad program of research on this process are being incorporated in the new plant, which will consist of four distinct parts: (1) Coal gasification; (2) gas purification; (3) hydrocarbon synthesis; and (4) refining of products.

Coal gasification is not only the first step in both basic processes for the production of synthetic liquid fuels but the No. 1 cost problem at this time. For this reason, priority has been given this phase of the construction, and runs will be made in this unit while the synthesis section is being completed.

Briefly, the plant's coal gasification cycle involves first crushing, pulverizing, and drying the coal. Then, suspended in oxygen and accompanied by superheated steam, the coal will be fed into a continuous gasifier—a refractory-lined steel shell 6.5 by 9 ft, internal measurement. There the conversion takes place at more than 2,000F. The required oxygen is extracted from the air at temperatures more than 300F below zero in a Linde-Frankl unit imported from Germany and reconditioned before being put into service.

After purification, the synthesis gas produced is ready for conversion to liquid fuels. Two new type converters developed in the Bureau's laboratories will be employed in an effort to obtain maximum efficiency. Both offer a high yield of oil and a low yield of the less valuable gases. In one, the internally-cooled converter, the heat of the synthesis reaction is rapidly removed by the circulation of a coolant oil through a fixed bed of catalyst granules. In the other, the oil-catalyst slurry converter, a powdered catalyst is suspended in a coolant oil, and the synthesis gas is bubbled through this rapidly circulated slurry.

An effective answer to the heat of reaction problem that limited the cumbersome and expensive German converters to a capacity of 18 barrels of oil a day, these improved converters each can be built to produce 500 or more barrels daily.

As a final step, the products from the converters will be treated in a distillation and refining section to separate the various fractions. It is anticipated that this demonstration plant will produce daily about 55 barrels of finished gasoline; 10 barrels of Diesel oil; 12 barrels of heavy oils and waxes; and 5 to 10 barrels of propane.

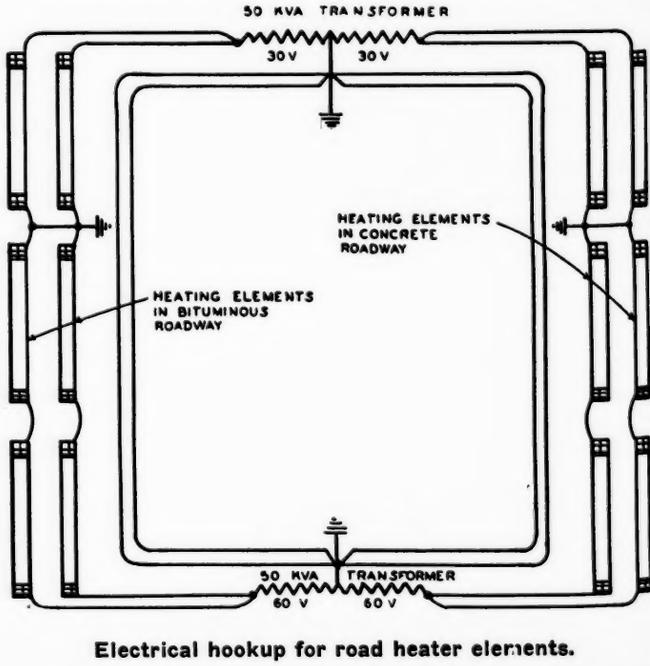
ELECTRIC ROAD HEATERS

used in Michigan's experiment in snow and ice removal on highways by radiant heat.

Laboratory tests conducted in 1935 by the Engineering Experiment Station at Michigan State College and a more recent experimental installation made during the winter of 1947-48 by the Detroit Public Lighting Commission have indicated that the heating of pavement surfaces by electricity to remove snow and ice may be feasible and practical at nominal cost.

• **TRIAL.**—As a result of the above experimental work, the Michigan State Highway Department authorized the installation during the summer of 1948 of a 1000-ft trial section on a regular construction project. It was believed that from a practical installation of this type a better knowledge could be acquired relative to cost data and performance of the system under winter conditions, according to a progress report released by Charles M. Ziegler, Michigan State Highway Commissioner.

• **SURFACES.**—The site selected for the experiment is on route M-102 at the west limits of Ferndale, a



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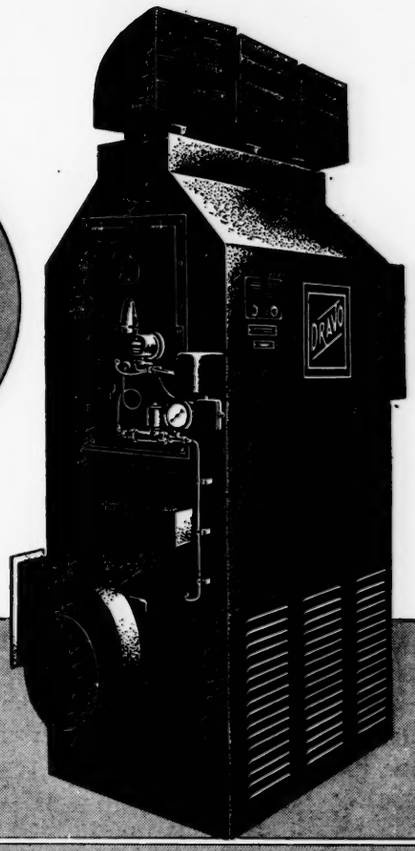

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suburb of Detroit. At this location, rout M-102 is a divided highway with the north roadway a concrete surface and the south roadway a bituminous surface. It is planned to study the relative construction and effectiveness of the method on two types of highway surfaces, bituminous and concrete. The test area for each type of surface is 500 ft in length and located in the inside lane only, of the two roadways.

• **ELEMENTS.**—Each installation uses heating elements consisting of 98-ft lengths of 2- x 2-in. standard concrete sidewalk reinforcing mesh composed of No. 14-gage galvanized iron wire, 18 inches wide. It was necessary to use this length of heating element because the pavement joints were at 99-ft intervals. Two heating elements were put in one pavement lane at 6-ft centers. At the end of each heating element, a ¼- x 2-in. copper bar and terminal wires were brazed to permit connection to the source of power. In the concrete pavement the heating elements were placed two inches below the surface. In the bituminous surface the elements were placed between the base and top course. The top course was approximately 1¼ in. thick. The heating elements were coated with an insulating varnish to eliminate any possibility of electric shock to persons or animals.

• **POWER.**—The system has been designed to operate on approximately 50 watts per square foot of heating element. This value was determined from a former experiment by the Detroit Public Lighting Commission to be the most practical for weather and power conditions in Detroit and vicinity. The e.m.f. is kept at 60 volts maximum. Both sides of the roadway are at the same potential and the drop along the roadway is 0.3 volts per foot.

• **CONTROL.**—The control system consists of two recording temperature controllers, one for each roadway, and associated relaying. These controllers are operated by bulbs placed in the pavement halfway between the heating element and pavement surface. When the temperature approaches freezing, the controller energizes the heating elements. After a sufficient rise in temperature, the controller turns off the heating elements. The present settings are 36F "on" and 38F "off." These settings allow for the temperature gradient which exists between the surface of the roadway and the point below the surface at which the temperature detector is embedded.

At the present time, the master control for this pavement heating installation is turned on by hand about one hour before a snow storm or ice condition as predicted by the local weather bureau, and is turned off by hand from observation of all conditions, both weather and pavement.

• **COSTS.**—Complete installation costs or operating costs are not available at this time, since minor changes in the electrical equipment are still in progress to improve performance. However, it is estimated that with electric rates at one cent per kilowatt hour, and the system using current only half of the time, operating costs for the 1000-ft section will be approximately 75 cents per hour.

FINNED TUBE PERFORMANCE

tested in Lehigh University unit controlling heat exchange conditions for heating and cooling.

Fundamental data covering the performance of finned tubing in heat exchange applications is being gathered by the Lehigh University Institute of Research, according to Dr. Darrel E. Mack, director of the project which is a cooperative research program with the David E. Kennedy Corp. of Brooklyn, N. Y.

• **TEST UNIT.**—For rapid determinations on the heating, cooling, and refrigerating of air through the use of extended surface tubing, the Institute developed a

Laboratory setup for finned tube tests.

test unit which made possible simultaneously controlled conditions of temperature, air velocity, and humidity.

The five-element unit permitted the introduction of either steam or refrigerant into the tubing under test measured the air flow rate and air temperature, determined the amount of moisture in the air, and recorded pressure loss through the coils. Controlled flow of refrigerant was made possible by an adjustable Freon refrigerating unit, and humidity was varied by use of spray humidifiers.

The variability of the 35-ft test unit was required Dr. Mack explained, because of the use of finned tubing under greatly varying conditions in unit air heaters air conditioning equipment, air cooled heat exchangers in chemical installations where cooling water is scarce and in heat exchangers where space or weight is at a premium.

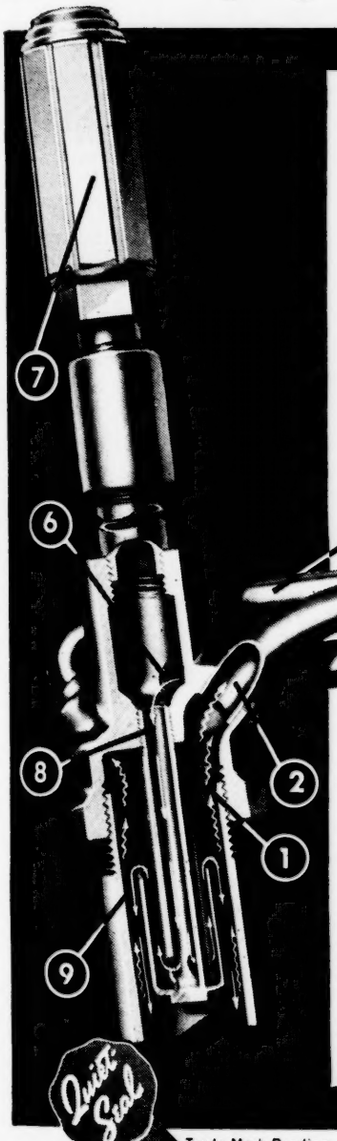
NEW TEMPERATURE SCALE

adopted as international standard at Paris conference to be used by Bureau of Standards.

On January 1, 1949, the National Bureau of Standards began using the definitions of the International Temperature Scale of 1948, both in its own research program and in calibrating instruments for other scientific and industrial purposes. Based on a draft prepared by members of the Bureau staff, the new scale was adopted at Paris by the Ninth General Conference

DESIGNED FOR 1-PIPE STEAM!

New Modine Quiet-Seal Convector—Cuts Installation Costs—Reduces Piping Costs—Actually Gives You 2-Pipe Performance



WHAT IT IS: The new Modine *Quiet-Seal* is a convector designed *specifically* for 1-pipe steam heating systems. It gives you all the economies of 1-pipe steam *plus* the superb heating comfort, individual room temperature control, attractive styling and easy installation of the beautiful new Modine Convector Radiation line. *Quiet-Seal's* design eliminates troubles that result when 2-pipe steam or hot water convectors are adapted to 1-pipe systems. Its one-way flow principle gives you noiseless operation, full heating capacity, fast positive air elimination. Water spitting is eliminated because *Quiet-Seal's* built-in water seal insures free venting. What's more, patented damper permits individual room temperature control not available with ordinary radiators.

HOW IT OPERATES: *Quiet-Seal's* one-way flow principle (proved in thousands of pre-war installations) is shown in cutaway illustration above. Steam enters inlet header (1), is directed into upper tubes (2), passes through these tubes (3), to cross header located at extreme right of illustration. At (4) and (5), steam and condensate are directed to lower tube. Condensate, steam and air are returned through lower tube at (6), at which point air rises in header to air vent (7) where it's freely discharged. Condensate is spilled into built-in trap (8), overflows water seal of trap (9) and drains into supply branch. All components of the *Quiet-Seal* Convector — except ½ inch shank, air vent, coupling, nipples and iron riser — are furnished by Modine.

Trade Mark Pending

*Design and Mechanical Patents Pending

Modine's New 1-Pipe Convector—the Quiet-Seal—is designed for use with the line of beautiful new Modine Convector enclosures. For all the facts on Quiet-Seal, see your Modine Representative. He's listed in the "Where-to-Buy-it" section of your phone book. Or send in coupon at right.

Modine

Quiet-Seal CONVECTORS

MODINE MANUFACTURING CO.
1511 Dekoven Avenue, Racine, Wisconsin

Gentlemen: Yes! I want Bulletin 249-B describing the New Modine Quiet-Seal Convector for 1-pipe steam systems.

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R-1014-r

on Weights and Measures in October 1948, and the official text was approved for publication before the end of the year. This is the first revision of the International Temperature Scale since its adoption 21 years ago. The experimental procedures by which the scale is to be realized are substantially unchanged; but certain refinements, based upon experience, have been incorporated to make the scale more uniform and reproducible.

• **BASIS.**—The experimental difficulties inherent in the measurement of temperature on the thermodynamic scale (an ideal scale based on energy changes in a Carnot cycle) led to the establishment in 1927 of the practical scale known as the International Temperature Scale. This is based upon six reproducible equilibrium temperatures, or "fixed points," to which numerical values are assigned, and upon specified interpolation formulas relating temperature to the indications of specified standard temperature-measuring instruments. The scale is designed to conform, as nearly as practicable, to the thermodynamic Celsius scale as it is now known. At the present time, however, it is possible to obtain values of temperature on the International Temperature Scale more accurately than on any thermodynamic scale. The Ninth General Conference decided to abandon the designation *Centigrade* and use *Celsius* instead.

The International Temperature Scale of 1927 proved useful in providing a stable, uniform, and precise basis for obtaining temperatures. However, since the adoption of this scale, the increasing precision attained in temperature measurements had made it apparent that some revision was desirable in order that measurements of physical constants—for example, the freezing and boiling points of pure compounds—might be made on a more exactly comparable basis by laboratories in all parts of the world. Because of the present leadership of the United States in the fields of heat and thermometry, the major responsibility for proposing and obtaining agreement on the changes fell to the National Bureau of Standards. After many consultations with scientists and laboratories in this country and abroad, the Bureau prepared a draft which formed the basis of the document finally adopted by the General Conference as the International Temperature Scale of 1948.

• **POINTS.**—The six fixed points of the 1927 scale were the boiling point of oxygen (—182.97°C), the freezing and boiling points of water, the boiling point of sulfur (+444.60°C), the melting point of silver (+960.5°C), and the melting point of gold (+1063°C). From —190° to +660°C, the measure of temperature was based on the indications of a standard platinum-resistance thermometer used in accordance with specified formulas. From +660°C to the gold point, a platinum-platinum rhodium thermocouple was the reference instrument; and above the gold point, the optical pyrometer has been standard.

• **CHANGES.**—The same fixed points, with one slight modification, are specified in the 1948 scale, and the laboratory procedures for obtaining temperatures between fixed points are essentially the same as those previously used. Only two revisions in the definition of the scale result in appreciable changes in the numerical values assigned to measured temperatures. One of these is the change in the value for the silver point from 960.5° to 960.8°C, which affects temperatures measured with the standard thermocouple. Thus, in the range between 630° and 1063°C, numerical values of temperature are higher than on the 1927 scale, the maximum difference being about 0.4 degree near 800°C. The adoption of a new value (1.438 cm-deg) for the constant c_2 in the radiation, formulas changes all temperatures above the gold point. In the new scale, Planck's radiation formula is specified instead of Wien's for calculating temperatures above the gold point as observed with an optical pyrometer. Since Planck's law is consistent with the thermodynamic scale even at high temperatures, this change removes the upper limit to the scale formerly imposed by the use of Wien's law.

There are several other important modifications in the scale which cause little or no change in numerical values for temperatures but serve to make the temperatures more definite and reproducible. For example, the standard platinum resistance thermometer is to be used as a reference instrument from the oxygen point to the freezing point of antimony (about 630°C), rather than over the range from —190° to +660°C. Platinum of higher purity is also specified for the standard resistance thermometer and standard thermocouple, and smaller permissible limits are given for the electromotive force of the standard thermocouple at the gold point.

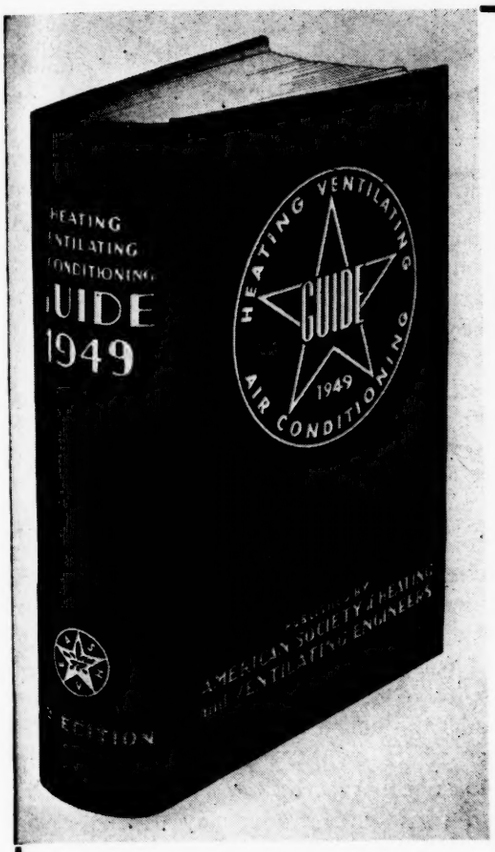
BUILDING RESEARCH

to be coordinated by government – industry – education advisory board.

The National Research Council announced last month that its new Building Research Advisory Board (H&V:3:49:p.57) had met and organized itself into a non-partisan, fact-finding group for government, private industry and educational institutions, to help mobilize American research talent on a public service basis to produce facts aimed at providing more and better building construction, including housing for more people at lower cost.

• **FACT FINDING.**—The board will not directly engage in research activities but will limit itself to presenting facts, based on the best available scientific information, according to Dr. Frank B. Jewett of Short Hills, N. J., chairman of BRAB.

The Building Research Advisory Board is not constituted to carry on research activities itself, according to Chairman Dr. Frank B. Jewett, but it will stimulate and encourage research activity at existing facilities of private industry, educational institutions and the government. The board believes that its maximum service to the nation can best be achieved



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CODES—Convenient reference list of 115 codes and standards relating to Heating, Ventilating and Air Conditioning.

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GAS and OIL BURNING

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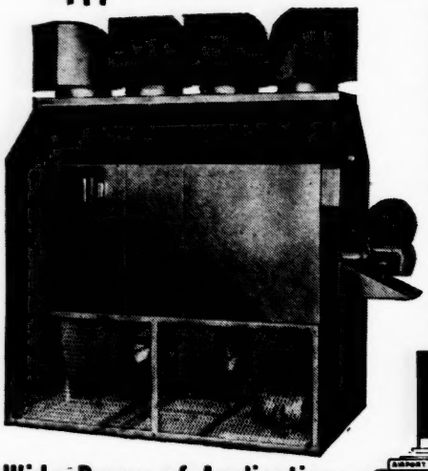
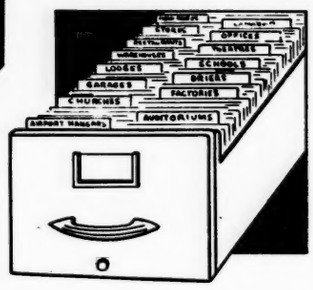
DIRECT FIRED UNIT



A self-contained unit with adjustable discharge heads for positive heat delivery in any direction. Streamlined fire box of high heat and corrosion resisting Type 310 Stainless Steel insures a far longer life of service and satisfaction. Tear Drop combustion chamber design and convector tube arrangement affords complete efficient air wipage of all heating surface at minimum resistance. Available in models for central heating systems employing supply and return ducts.



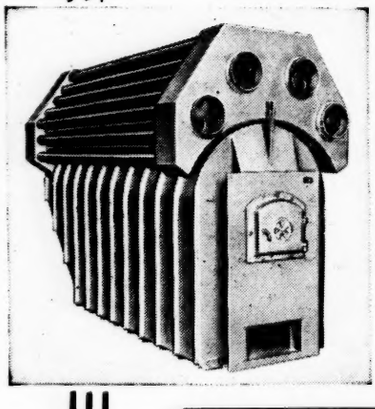
Wide Range of Applications

These units have proven practical and economical for most types of public, commercial and industrial buildings. National Champion heaters are the product of over a half century of experience in this field and the latest advanced engineering features of these units have been tested in a rapidly increasing range of actual installations.

GENERAL CAPACITY DATA

Model Number	Btu	Cfm	hp	Dimensions (inches) length-width-height			Approximate Shipping Wt., Lbs.
T.D.— 25	250,000	3,600	¾	60	32	81	1,300
T.D.— 40	400,000	5,400	1	60	32	81	1,350
T.D.— 50	500,000	6,600	1½	80	32	81	1,780
T.D.— 70	750,000	8,800	2	80	32	81	1,855
T.D.— 80	800,000	10,200	3	80	48	81	2,110
T.D.—100	1,000,000	12,500	5	80	48	81	2,200
T.D.—125	1,250,000	15,300	5	100	54	103	3,000
T.D.—150	1,500,000	19,400	7½	100	54	103	3,250

NATIONAL HEATER



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FORCED AIR UNIT

Specifically constructed and designed for stoker and hand firing with blower position at rear of casing, this unit embodies all the features of other NATIONAL heaters for greater satisfaction and economy of operation. Can be quickly and efficiently converted to light oil, heavy oil or gas firing as future fuel costs and supplies may necessitate.

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by giving the widest distribution to well-authenticated facts on controversial subjects. It will leave to others the interpretation as to what courses of action might be justified by these facts, said Dr. Jewett.

• **OBJECTIVE.**—While the first meeting of the board was exploratory in nature, and it was recognized that some time might elapse before methods of operation and policies can be established on a permanent basis, several decisions were made that have started the board moving toward its ultimate objective.

Among these are:

1. The board instructed a subcommittee under the chairmanship of Dr. Jewett to proceed at once in selecting a candidate to be recommended to the board as a permanent, full-time director, responsible for carrying on the board's activities and building up a technical staff for this purpose.
2. A commission was accepted from the Federal Housing and Home Finance Agency to undertake a study of why modular coordination has not found wider practical use in home construction in spite of its extensive technical development. Since the board does not yet have a technical staff of its own, a subcommittee was appointed to subcontract this work; supervise the study and pass on the adequacy of the report submitted.
3. The board agreed that the initial efforts of the permanent director, when selected, should be on exploring experimentally the best methods for analyzing the research needs of the building construction industry and the extent to which these needs are being investigated at the present time. Areas which seem to be most in need of research assistance would be selected for preliminary investigation.
4. The board authorized its temporary executive committee to carry on the board's activities until the next meeting is called and to accept, subcontract, and supervise any further commissions which the board may be offered and which it seems logical to accept.

It was estimated that $100,000 a year will be needed to finance the non-partisan activities of the Building Research Advisory Board. These funds are now being collected from various elements of the construction industry.

NEWS BRIEFS

• The Federal Power Commission has agreed to pass directly on the application of Texas Gas Transmission Corporation to construct an *800-mile natural gas pipeline* from Texas to Ohio, thereby waiving the intermediate procedure requiring a recommendation by the Trial Examiner. Texas Gas has already taken many steps to have the proposed $73,500,000 project in operation by the end of the year.

(More News Briefs on page 130)

KRITZER

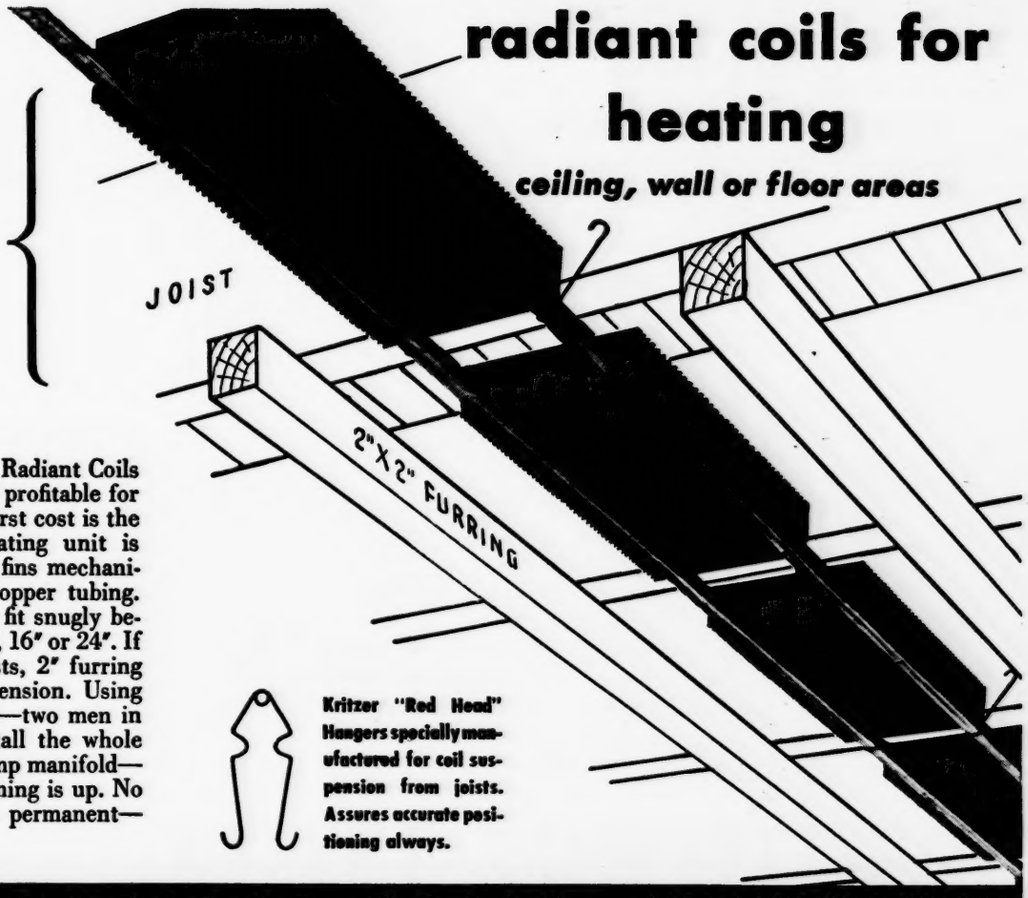
THE NEW HOT WATER HEATING UNIT THAT CAN BE INSTALLED QUICKLY—CHEAPLY

Permanent
Lightweight
Economical

Designed to fit easily into all structural areas

radiant coils for heating

ceiling, wall or floor areas



● Start at once to install Kritzer Radiant Coils on your jobs—it's easy to do and profitable for you—cuts down on estimating—first cost is the last cost. This new radiant heating unit is simple—just aluminum radiating fins mechanically bonded to ⅝", 3" center copper tubing. Each coil section is fabricated to fit snugly between joist or stud spacings of 12", 16" or 24". If coil sections are hung below joists, 2" furring strips are added for ceiling suspension. Using Kritzer Radiant Coils saves labor—two men in a few hours can completely install the whole heating layout right up to the pump manifold—and *do it*, just as soon as the framing is up. No extras. No call-backs. Kritzer is permanent—once it's in, it's in.

Kritzer "Red Head" Hangers specially manufactured for coil suspension from joists. Assures accurate positioning always.

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How a fast-running repair job is done in an old hotel

You can do *more work* every day when you bend pipe with a

TAL *Portable* Bender

Work goes faster when you *bend on the job* — either original installation, radiant heat or repair. Fewer joints to leak in the future, less friction, more satisfaction for your customers and a bigger profit for you. Do as hundreds everywhere are already doing. Write for illustrated data bulletin. Dept. 12.

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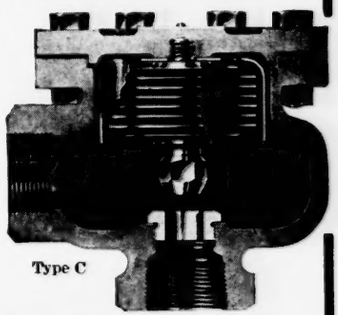
NICHOLSON TRAPS SPEED UP CIRCULATION

of Steam



Type C

7 REASONS WHY:

1. **BIG DISCHARGE, 2 to 6 times average traps.**
2. **NO AIR - BINDING. Discharge both air and water.**
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5 TYPES for every industrial application. Sizes ¼" to 2"; pressure to 225 lbs.

4. **NO DRIBBLING. Close tight when steam is in trap.**
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7. **LOWEST STEAM WASTE. As little as 1%.**

Bulletin 1047 or see Sweet's

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TOOLS FOR CRAFTSMEN
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(News Briefs continued)

• Two *continuous mining machines* are now being manufactured. One is by Joy Manufacturing Co., Pittsburgh, Pa., who claim their new machine performs the whole mining cycle of cutting, drilling, blasting, and loading two tons a minute by means of carbide ripping bits on bit chains. The other machine is by Sunnyhill Coal Co., Pittsburgh, Pa. It is called the Colmol and uses rotary chipping heads.

• A $1 million contract for refrigeration equipment has just been signed by Carrier Corp. with Bergen Fiskeindustri A. S., Norway. When completed in 1952 the plant will be *one of the largest* of its kind in the world and will increase Norway's capacity to produce frozen fish and other foods by 82,000 tons a year.

• Approximately $6 million in cash and securities has been given to the Carnegie Institute of Technology by The W. L. and May T. Mellon Foundation to establish the nation's *first graduate school of industrial administration.* At least $1 million of the Foundation's gift will be used to erect a building on the Tech campus and about $5 million to endow the new school.

• The Construction Industry Information Committee has announced that more than *80,000 public construction projects* have been started since the end of the war. The total includes more than 7,200 educational projects on schools, colleges, and libraries.

• Continuing consumer *demand for non-ferrous convector-radiators* in new and modernized homes, apartments, schools, hopitals and other institutional buildings is reflected in total shipments of 412,019 convector units in the first nine months of 1948, according to a report from the Convector Manufacturers Association.

• An *out-of-doors testing station* in Miami, Florida, provides maximum exposure to the sun's rays for weather testing of materials and products. Sam Tour & Co., Inc., of New York have arranged for setting up the testing materials.

• New York City's newest skyscraper under construction at 100 Park Avenue will be completely air conditioned. Jaros, Baum & Bolles are the consulting engineers. The structure will be 36 stories high and will cost $20 million and feature an unique zone system for *conditioning independently* both inner and outer spaces of each floor.

• The New York Association of Consulting Engineers has endorsed Governor Dewey's program to *standardize local building codes* in New York State and offered the assistance of the association in working out technical details.

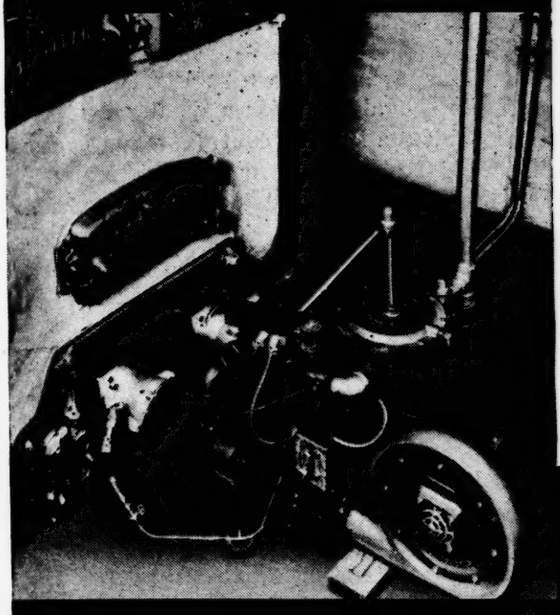
• Factory sales of *mechanical and automatic coal stokers* of all sizes for the year 1948 totaled 85,378 units as compared with 68,908 units in 1947.

• Exhibit space in the *National Oil Heat Exposition* to be held in Boston May 16 to 20 is over 95% taken, according to A. E. Hess, managing director of the Oil-Heat Institute of America.

Bryant Industrial

SERIES "BB"

BOILER BURNERS



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For boilers up to 180 horsepower. Bryant Boiler Burners are assembled as complete packages including single or twin nozzle "Pow-R-Semblies" and all necessary protective and control equipment. *Write for Data Sheet 4F-1 describing complete package.*

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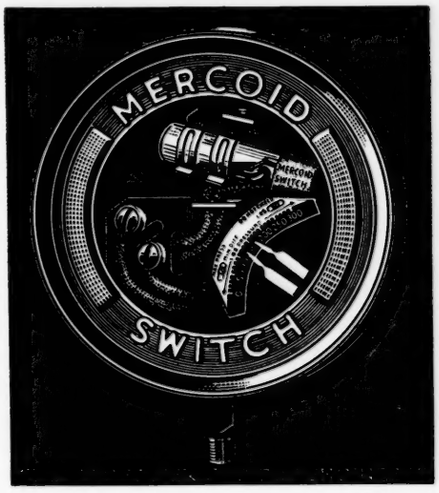

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AUTOMATIC CONTROLS FOR INDUSTRIAL APPLICATIONS REQUIRING POSITIVE CONTROL OF PRESSURE, TEMPERATURE, LIQUID LEVEL ETC.

SIMPLE TO ADJUST FOR THE SPECIFIED OPERATING RANGE

MERCOID CONTROLS ARE EQUIPPED WITH MERCURY SWITCHES, THEREBY INSURING GREATER SAFETY, BETTER PERFORMANCE AND LONGER CONTROL LIFE

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4201 BELMONT AVE. CHICAGO 41, ILL.

24-inch EXHAUST FAN WITH MOTOR

$19.95

OD 28 x 28

This Coupon and $19.95 entitles you to a 24" belt drive exhaust fan complete with 110 volt, 60 cycle motor. Regular $59.00 list. Order MUST be received before May 2, 1949. Shipment made in rotation only. Wholesale price usually $29.50 (also this price without coupon).

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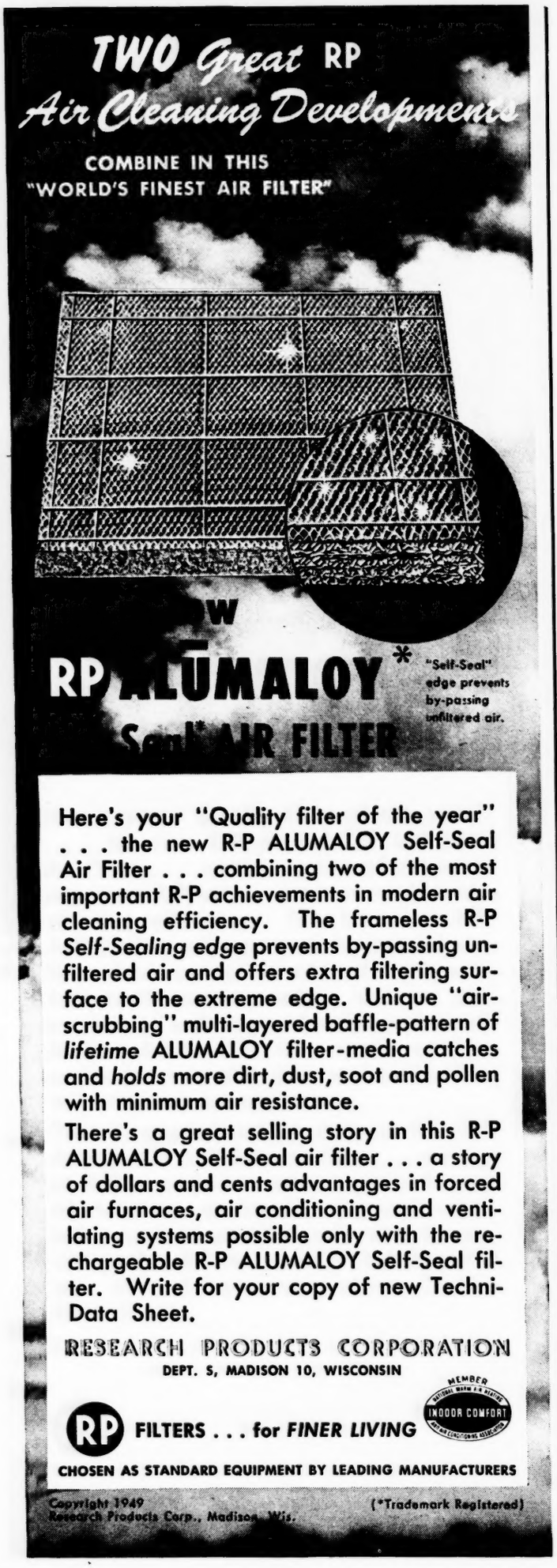
MANUFACTURING CO., INC.
WEST BERLIN, NEW JERSEY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ABSTRACTS AND REVIEWS

(Concluded from page 116)

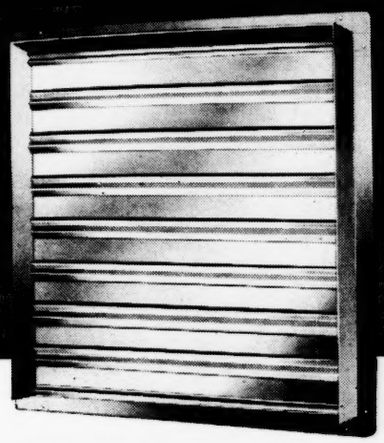
CLASSIFYING WARM AIR SYSTEMS — The Research Advisory Committee and the Installation Codes Committee of the National Warm Air Heating and Air Conditioning Association have authorized a publication termed "A Yardstick for Classifying Warm Air, Winter Air Conditioning Systems." This 23-page illustrated booklet attempts to explain for the benefit of the homeowner what constitutes a good warm air winter air conditioning system with specifications he and his architects should have for a quality installation, and with features a heating contractor could offer in accordance with the best modern practice. Many of the basic terms are illustrated and described. Good and poor design practices are illustrated. Price, 60¢ a copy. National Warm Air Heating and Air Conditioning Association, 145 Public Sq., Cleveland 14, Ohio.

CORROSION TESTS OF IRON AND STEEL PIPES—In a publication issued by the American Society for Testing Materials, information is presented on laboratory corrosion tests of iron and steel pipes. It is contained in a paper, "Laboratory Corrosion Tests of Iron and Steel Pipes." Continuous flow laboratory corrosion tests of ten types of uncoated ferrous pipes were made over periods of time extending up to ten years. The corroding medium was Washington, D. C., tap water continuously circulated through columns of the test samples. Corrosion was measured as loss of weight and depth of pits in relation to the time of exposure. While most of the pipes corroded at somewhat similar rates, there were small but real differences in the corrosion of some materials. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

HOUSING IMPROVEMENT SINCE 1940—The Construction Industry Information Committee of the Producers' Council, Inc., has released an 11-page booklet on "Our Housing Improvement Since 1940" which presents through text and tabular material changes that have taken place in the housing picture. This booklet discusses improvement in occupancy standard, improvement in the quality of nonfarm housing, increase in the number of private toilets and baths, number of persons per room occupying dwelling units, volume estimates of housing inventory and construction and technical notes on the estimates of housing improvement. This publication, which is No. 9 of a series, may be obtained by writing to the Committee at Room 706, 815 15th St., N.W., Washington 5, D. C.

MINERAL WOOL INSULATION STANDARD — In the joint sponsorship of the National Bureau of Standards and the Industrial Mineral Wool Institute, a 26-page commercial standard numbered CS105-48 has been prepared on mineral wool insulations for low temperatures. This standard supersedes the 1943 edition and includes a number of major additions to bring the material up to date. The standard covers loose, granulated felt; industrial batt; and board or block forms. Industrial Mineral Wool Institute, 441 Lexington Ave., New York 17, N. Y.

they all want AIR-FLO



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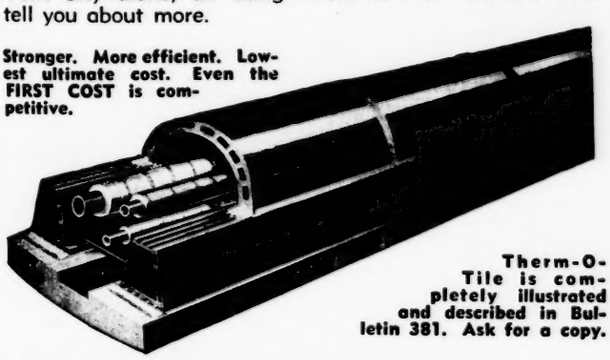
Stronger. More efficient. Lowest ultimate cost. Even the FIRST COST is competitive.



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in "Industrial & Engineering Chemistry."

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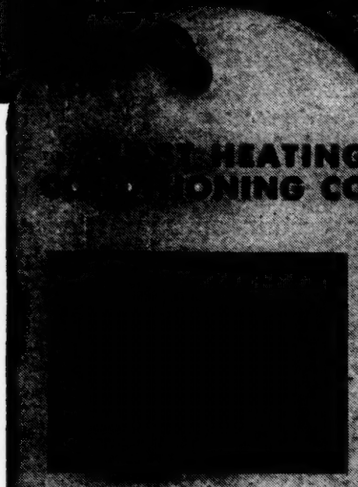

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NEW CATALOGS

Hot Water Heating

Janitrol triple service hot water heating systems are described in a 12-page booklet which shows how the triple service may be used for hot water heat by convector or radiant panel as well as for domestic hot water at different temperatures for household functions. — *Surface Combustion Corporation, Toledo 1, Ohio.* 59

Air Conditioning Coils

Direct expansion, steam, and water air conditioning coils are described and illustrated in a 42-page catalog including selection data, steam properties, "K" factors, friction factors, and psychrometric tables and charts.—*Kramer-Trenton Co., Trenton 5, N. J.* 60

Residential Gas Boiler

The new 22 series National gas boiler is described in a 12-page bulletin No. 542 available in six sizes for both hot water and steam heating systems with ratings from 25,200 to 93,800 Btu per hour. Roughing-in dimensions and data tables for various gases are included.—*The National Radiator Company, Johnstown, Pa.* 61

Blast Furnace Gas Burners

Ways and means to utilize waste fuels are covered in a two-colored bulletin on the Peabody line of blast furnace gas burners.—*Peabody Engineering Corp., 580 Fifth Avenue, New York 19, N. Y.* 62

Scotch Boilers

Johnston Scotch boilers are described and illustrated in bulletin 506, 4 pages. Line includes boilers for high pressure and low pressure service and packaged steam generators.—*Johnston Brothers, Inc., Ferrysburg, Mich.* 63

Insulated Piping Systems

Two new booklets deal with problems involved in insulated piping distribution systems. Ric-wiL catalog section 480-2 presents engineering data for underground steam distribution and covers layouts, load estimating, steam flow charts and tables. Section 480-3 presents typical engineering drawings and reproduces actual drawings used in a variety of insulated piping installations.—*The Ric-wiL Company, Dept. A23, Union Commerce Bldg., Cleveland, Ohio.* 64

Boiler Working Pressure Data

Maximum allowable working pressures for water-tube and fire-tube boilers have been assembled in the form of a table, data card No. 113, which lists the maximum allowable working pressures in pounds per square inch for seamless and electric-resistance welded carbon steel tubes or nipples for different diameters and gages of tubes conforming to certain A.S.M.E. specifications.—*The Babcock & Wilcox Tube Co., Beaver Falls, Pa.* 65

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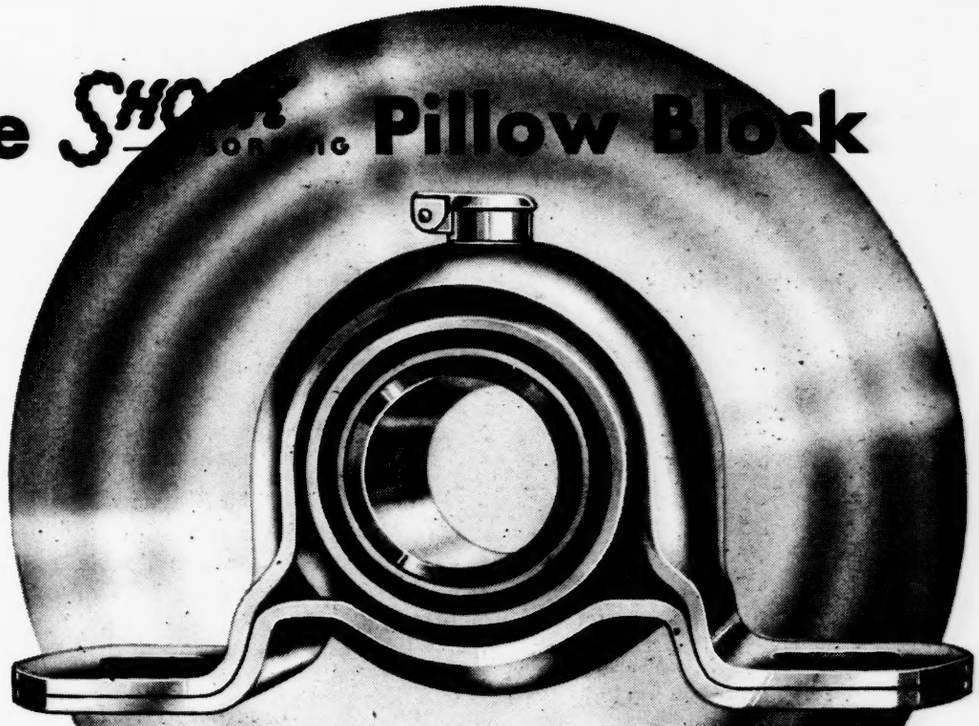

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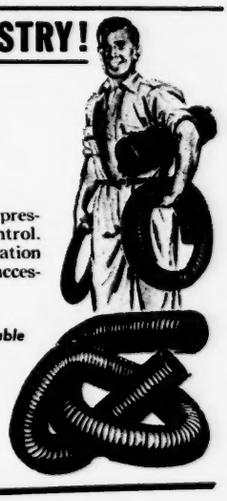

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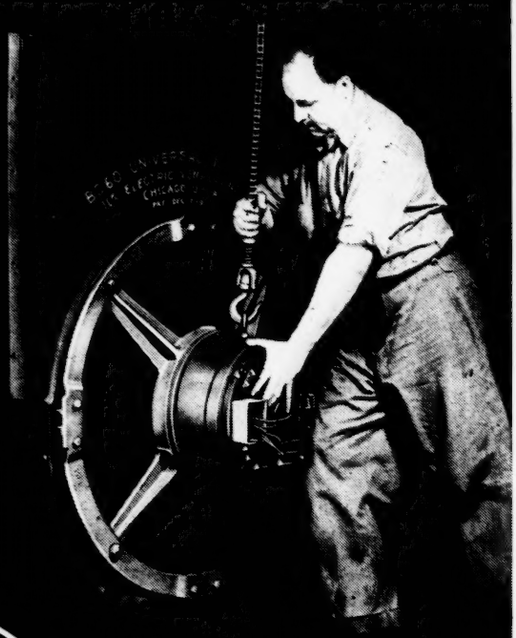

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Piping Joint Data

Data on mechanical pipe joints are offered in No. 6.01 in the Tube Turns series of folders on piping engineering. Bulletin covers standard steel pipe flanges with drawings, tables and specifications.—*Tube Turns, Inc., Louisville 1, Ky.* 66

Air Test Instruments

A 6-page bulletin describes and illustrates gages, pitot tubes, smoke bombs, and other instruments for air measurement and analysis.—*E. Vernon Hill & Co., 6826 W. Highland Ave., Chicago 31, Ill.* 67

Automatic Filter

The Staynew Model A-3 four stage automatic filter is described and illustrated in an 8-page bulletin. Filter has double curtains traveling on rollers and cleaned in bath of oil. Diagrams and capacity tables are included.—*Dollinger Corp., 11 Centre Park, Rochester 3, N. Y.* 68

Direct-Fired Heaters

Counterflo forced air space heaters in capacities from 400,000 to 2,000,000 Btu per hr are described in a 12-page bulletin, No. 523. Units are direct-fired either by oil or gas and are used either with or without duct work in heating, ventilating, process drying, and curing.—*Dravo Corporation, Heating Section, Dravo Building, Pittsburgh 22, Pa.* 69

Dust Collectors

An 8-page bulletin, No. D-491, shows typical installations of Sly dust collectors.—*The W. W. Sly Manufacturing Co., 4700 Train Ave., Cleveland 2, Ohio.* 70

Motor Bulletins

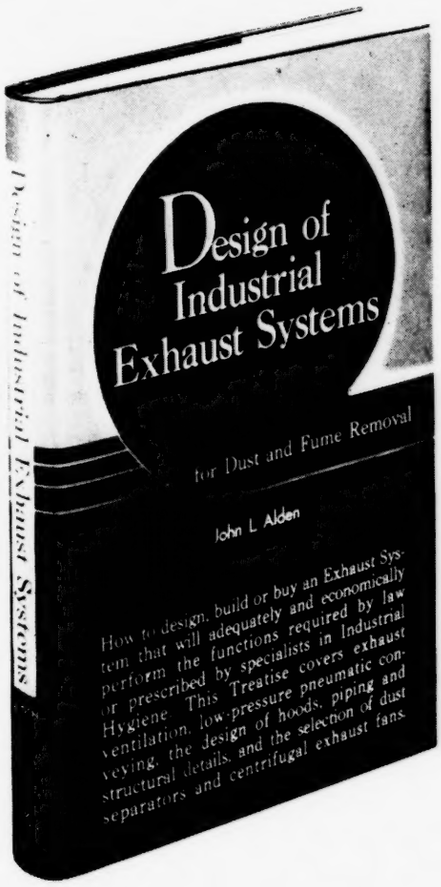
The complete line of Emerson Electric capacitor-start and oil burner motors are described in two bulletins, X6157 and X6160, respectively. Details of construction and dimension diagrams are included.—*The Emerson Electric Manufacturing Co., St. Louis 21, Mo.* 71

Cooling Towers and Nozzles

A looseleaf catalog describes water cooling equipment and industrial spray nozzles for refrigeration, air conditioning, and other fields where cooling towers and nozzles are used. Engineering information and data on cooling system designs are included. A special section describes atomizing nozzles for maintenance of constant relative humidity.—*Binks Manufacturing Co., 3122 Carroll Ave., Chicago 12, Ill.* 72

Fan Blades and Blowers

Performance and dimensional data of fan blades and blower wheels are included in a 16-page catalog. Recommended scroll dimensions and complete blower assemblies are included.—*Burden Company, 1000 N. Orange Dr., Los Angeles 38, Calif.* 73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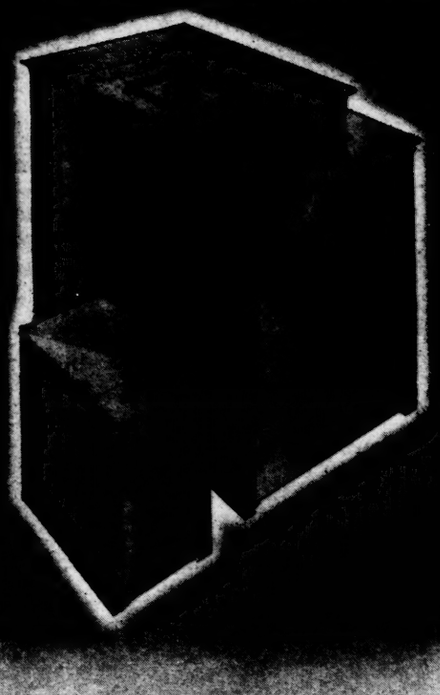

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Aluminum Ducts

Kaiser aluminum duct work is described and illustrated in a 20-page brochure with specifications and recommendations for duct construction and tables of comparative gage numbers and weights.—*Permanente Products Co., Oakland, Calif.* 74

Modulating Controls

Sylphon modulating controls for heating, ventilating and air conditioning are described in an 8-page folder with principal applications and drawings of hook-ups for unit heaters, radiators, cooling systems, etc.—*Fulton Sylphon Division, Robertshaw-Fulton Controls Co., Knoxville 4, Tenn.* 75

Automatic Controls

Catalog 600B describes Mercoid automatic controls for heating, air conditioning, refrigeration and various industrial applications. An index is included for quick reference to control uses. Latest price list is included.—*The Mercoid Corp., 4201 Belmont Avenue, Chicago 41, Ill.* 76

Copper Tube Connectors

Catalog No. 1949CP describes brass connectors for copper tube with photographs and price lists of various fittings. Bulletin is punched for looseleaf binding and a quantity discount sheet is included.—*The Couplings Co., 55 E. 18th St., Chicago 16, Ill.* 77

Steam Trap Problems

A 36-page booklet "Solving Steam Trap Problems" contains information for selection and installation of steam traps and direct trapping practice for unit heaters and kettles, kitchen and laundry equipment, steam mains, etc. Tables of specifications and capacities of Anderson traps are included. — *The V. D. Anderson Company, 1935 West 96th St., Cleveland 2, Ohio.* 78

Roof Insulation

Rock cork felt sided roof insulation is described in a 4-page bulletin with photographs and conductivity data.—*Johns-Manville, 22 E. 40th St., New York 16, N. Y.* 79

APRIL, 1949

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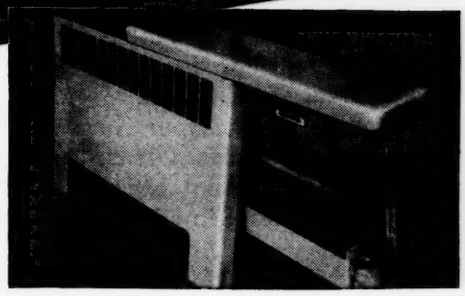

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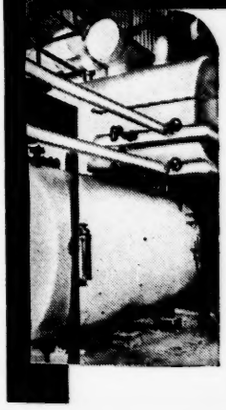

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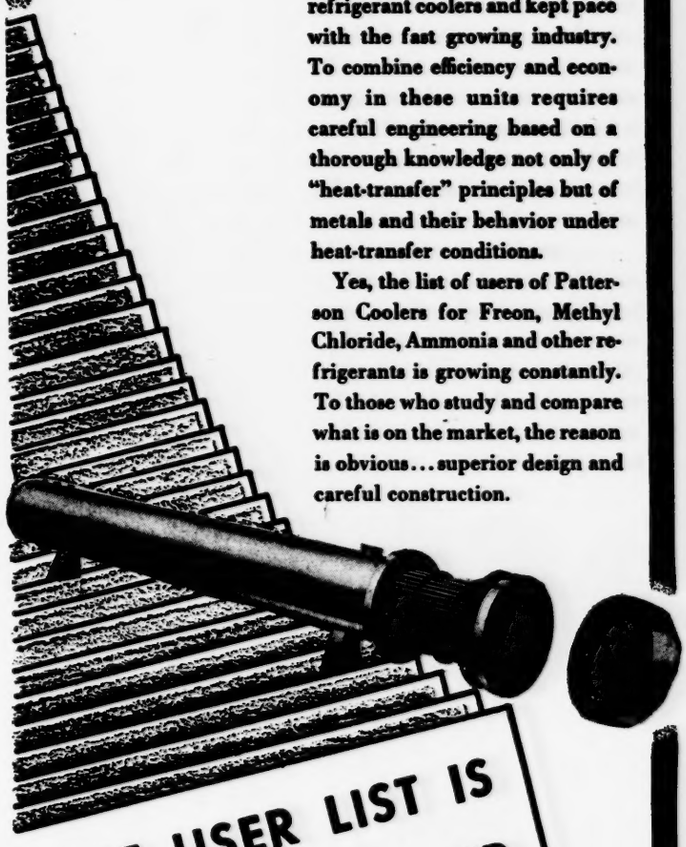

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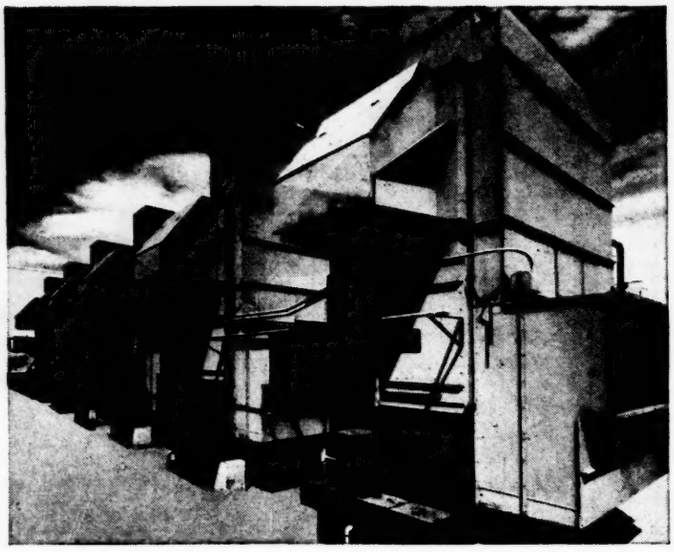

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HUMIDIFYING • AIR ENGINEERING EQUIPMENT

WHAT READERS SAY

Ozone and CO Neutralizing

EDITOR, HEATING AND VENTILATING

We have noted with interest the article regarding "CO Exposure in Auto Repair Shops" which was included on page 85 of your November 1948 issue. The article gives conclusions from a study of such conditions and at one point comments on the inadequacy of ozone generators in eliminating the carbon monoxide. Not mentioned, but we believe worthy of note, is the possible health hazard involved in the use of ozone generators in an effort to neutralize carbon monoxide. Entirely aside from the toxic oxides of nitrogen also formed with ozone-making equipment, the toxic hazard of any amounts of ozone which would be effective would be many times that of the carbon monoxide.

The American Conference of Governmental Industrial Hygienists has adopted 100 parts per million as maximum allowable concentration for safe exposure to carbon monoxide, whereas the comparable limit for ozone is only 1 part per million. In addition, it has been found by Clausmann (Compt. Rend. 150:1332, 1910) and others that ozone, even when in concentrated condition, gives only a slight reaction with carbon monoxide to form carbon dioxide. For example, with a mixture in sunlight for 8 days only 2.8% carbon dioxide was formed, and only 0.88% was obtained in darkness. Thus, even moderate concentrations of carbon monoxide would require for "neutralization" extremely hazardous amounts of the much more toxic ozone.

Very truly yours,

Norman Scott, Industrial Hygienist
Industrial and Adult Hygiene Section
Department of Health, Washington

Seattle, Wash.

Getting Personal

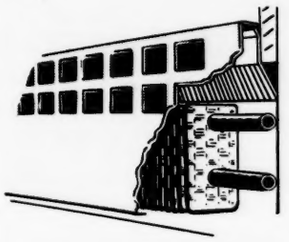
M. F. Mueller

Max F. Mueller *(Automatic Dehumidification of Vented Enclosures*, page 73) is a native of Michigan and a graduate of the University of Michigan, B.S. in Chemical Engineering, 1932. After graduation he worked in laboratory and on pilot plant development for Dow Chemical Co. In 1940 he entered the Ordnance Department, U. S. Army, on active duty. While serving overseas in Australia and New Guinea he became impressed with the tremendous waste of equipment caused by rust, rot and fungus deterioration. On his return to the U. S. he was appointed by the Ordnance Department as research coordinator of a program to determine methods of preserving military equipment for a period of 20 years without major disassembly. At the end of the war he received the Army commendation medal for this work. He joined the Davison Chemical Corp., Baltimore, Md., in

An Invitation TO PROFITS

with **BROWN BAYCE-HEET**
the New Aluminum Fin Baseboard

GIVES YOU THESE SELLING ADVANTAGES!



EASY TO INSTALL!

5 ft. unit weighs less than 12 lbs. Only 3 simple wall brackets necessary. Each installation takes only a few minutes.

MORE HEAT!

1080 B.T.U. per lineal foot with 215° water temperature through ⅝" copper tubing and 6 *aluminum* fins to the inch. 1¾" x 3¾" fins have amazing heat area due to an exclusive beading process which accounts for added turbulence and stiffening.

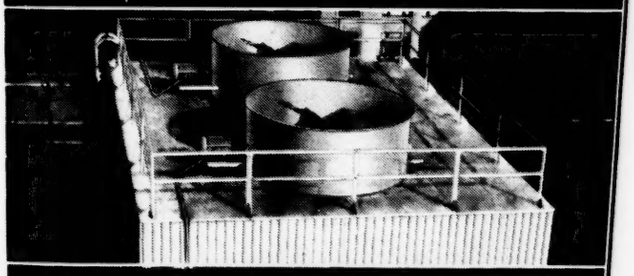
CLEAN AND NEAT

Closed top and open front prevent wall streaking from heat rise. Smart design protrudes from wall only 1⅛". Housewives find its removable front panel handy-for-cleaning.

5' Size in Stock
Other Specifications
Made to your order.
Write for complete Details Today!

BROWN PRODUCTS COMPANY
BROWN BAYCE-HEET
FOREST HILLS NEW YORK

Pritchard COOLING TOWERS



Thoroughly Engineered* ... Adequately Sized

THREE LEADING LINES
Cooling Towers
Heat Exchangers
Gas Equipment for
FIVE MAJOR FIELDS
Chemical, Natural Gas, Petroleum, Power and Refrigeration.

J.F. P Co.

***For Longer Life and Trouble-Free Performance**

EQUIPMENT DIVISION
908 Grand Ave. Kansas City 6, Mo.

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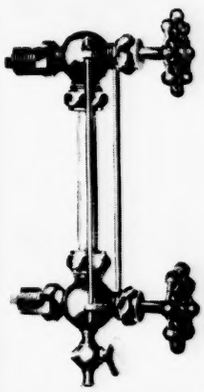
J.F. Pritchard & Co.
ENGINEERS • CONSTRUCTORS • MANUFACTURERS
for the CHEMICAL, PETROLEUM, GAS & POWER industries

FOR BETTER WATER GAUGES

USE *Roberts*

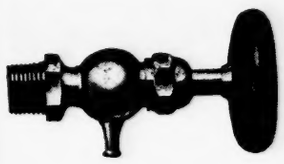
- **SOLID BRASS**
- **SELF-CLEANING**
- **FOR WORKING PRESSURES Up To 175 POUNDS**



For decades Roberts Water Gauges have been a standard of quality wherever tubular glass gauges are used.

Modern design—made of solid brass with plenty of strength. Self-cleaning feature keeps lower part of gauge from clogging with scale. Special packing allows free expansion of glass, avoiding breakage.

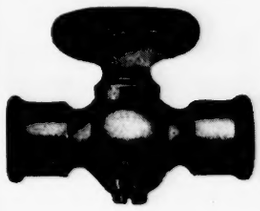
COMPRESSION GAUGE COCKS



Solid brass, durable, with seats that stand long use. Model shown has stuffing box.

Also offered in light pattern less stuffing box.

AIR COCKS—STEAM GAUGE COCKS



Roberts makes air cocks of all types and steam gauge cocks for pressure gauges.

All sizes – 1/8" up to 1/2".

Write for information on Roberts Gauges and Cocks.

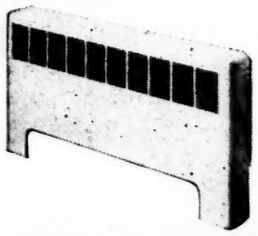
THE ROBERTS BRASS MANUFACTURING CO.

Manufacturers of Brass Goods for Steam, Water, Gas and Air

5435 WEST FORT ST. • DETROIT 9, MICH.

Good service is measured by how well it is tuned to your needs for plumbing and heating supplies. The proper materials, at the proper place, at the proper time is insurance that your jobs will progress smoothly and efficiently without costly delays. Hajoca Corporation, with more than 33,000 products at 31 Branches from New Jersey to Florida, is tuned to supply you promptly with America's leading plumbing and heating equipment and materials.

ONE OF 33,000 PRODUCTS . . .
Tuttle and Bailey *Copper Convectors*



The efficient, modern way to heat homes is with Copper Convectors. Developed over a period of years, today's Tuttle and Bailey Convectors are at the top in economical and completely satisfactory heat radiation. The coming warm months are ideal times to modernize heating systems. And remember, your local Hajoca Branch is ready to supply you with T & B Convectors, as well as all the pipe, valves, fittings and other plumbing and heating supplies you require.

Mail the coupon below for complete information and descriptive literature about Tuttle and Bailey Copper Convectors.

Please send at once latest Tuttle and Bailey literature about Copper Convectors.

Company_____

Address_____

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Your Name_____

P-8

HAJOCA CORPORATION

31 Branches Serving the Atlantic Seaboard
From Newark to Tampa and inland to Chattanooga
Consult your local telephone directory for your nearest branch
General Offices: 31st and Walnut Street Bridge
Philadelphia 4, Pa.

1945, and continued this work as consulting engineer to Army Ordnance. One phase of his work resulted in development of the Solar Radiation Breather. He is a member of the American Institute of Chemical Engineers and is a registered engineer in the state of Maryland.

H. M. Hendrickson

Harold M. Hendrickson *(Air Conditioning Retail Food Stores,* page 77) is chief engineer for the Ralph E. Manns Company, refrigeration engineers and contractors of Los Angeles, Calif. He was educated at the University of Washington, Seattle, Wash., receiving the degree of Bachelor of Science in Mechanical Engineering in 1927 and his professional mechanical engineer's degree in 1935. He has been associated with the refrigeration and air conditioning industry since 1923, having been in the employ of York Corp., Carrier Corp., and various consulting engineers and architects. From 1945 to 1947 he was employed by the Safeway Stores, Inc. of Oakland, Calif. to assist in the design of store air conditioning and plant refrigeration systems. Mr. Hendrickson is a member of the American Society of Heating and Ventilating Engineers, and was president of the Southern California Chapter in 1938. He is a fellow of the American Society of Refrigerating Engineers and has served for the past five years as a member of the A.S.R.E. Standards Committee. He has also authored several engineering Application Data sections and chapters for the A.S.R.E. Data Book, and is a registered professional mechanical engineer in California.

. . . Since the Last Issue

W. B. Connor Engineering Corp., New York, manufacturers of Dorex activated carbon air purification equipment, announce the following distributor appointments for their apply storage units: McCune Co., Youngstown, Ohio, for Ohio, western Pennsylvania and northern West Virginia; John Bacon Co., Gasport, N. Y., western and northern New York; Trobaugh Homestead, West Frankfort, Illinois, for southern Illinois and Indiana, and Frost Insecticide Co., Arlington, Mass., for New England.

Walter H. Holt, manager of the Fan Merchandise and Standard Apparatus Department, **Buffalo Forge Co.,** Buffalo, New York, was elected president of the Propeller Fan Manufacturers' Association at the annual meeting held at Atlanta, Ga., in February.

Carlos Morgan has been appointed acting advertising manager for **Penn Electric Switch Co.** He succeeds J. R. Netedu, former manager, who resigned to enter the advertising agency business. Mr. Morgan, who has been with the Penn Electric Switch Co. for the past 13 years, was formerly assistant advertising manager and has been connected with the company's advertising activities for several years.

J. L. Young, Jr., sales representative for **Wolverine Tube Division** (Detroit) with headquarters in Houston, Texas, has been promoted to manager of southwestern sales. Mr. Young will headquarter in the company's Houston office and guide Wolverine sales throughout Texas, Arkansas, Louisiana, Oklahoma, and supervise operation of the company's Mill Depot in Houston.

Glenn D. Culbert, 1006 DuPont Circle Bldg., Washington, D. C., has been appointed sales representative of **American District Steam Co.**

E. H. Davison has been appointed general sales manager of the Williams Oil-O-Matic Division of **Eureka Williams Corp.** Formerly manager of heating sales, Mr. Davison assumes the dealer-distributor sales supervisory duties of W. A. Matheson, whose resignation as executive vice president of the corporation became effective February 18th.

John S. McElwain has been appointed sales manager of the merchandise department for the **Avery Engineering Co.** Mr. McElwain is a graduate of the University of Virginia, served five years with the Armed Services, and has been Chicago representative of the Lemco Products Co.

Two new salesmen for **Taylor Instrument Companies,** one located at Portland, Oregon, the other at Los Angeles, have been appointed. **A. M. Wallace,** Portland, is a graduate of the University of Denver and also spent four years at Newark College of Engineering, Newark, New Jersey. **R. M. Garrett,** Los Angeles, is a Chemical Engineer from Ohio State University and also holds a Master's Degree in Business Administration.

The **American District Steam Co.** of North Tonawanda, N. Y., has announced the appointment of **Lyman D. Warner** as vice president. Mr. Warner will assist Samuel J. Childs, executive vice president and general manager. Mr. Warner was formerly sales manager of The Crocker-Wheeler Elec. Mfg. Co. of Ampere, N. J.

Announcement has been made by the Packaged Air Conditioning Sales Division of **United States Air Conditioning Corp.** that **Refrigeration Equipment Co.** of Kansas City, Mo., has become a major distributor selling usAIRco store conditioners, window air conditioners and console room conditioners through branch offices in Wichita, Topeka and St. Joseph, Mo., as well as the main office in Kansas City.

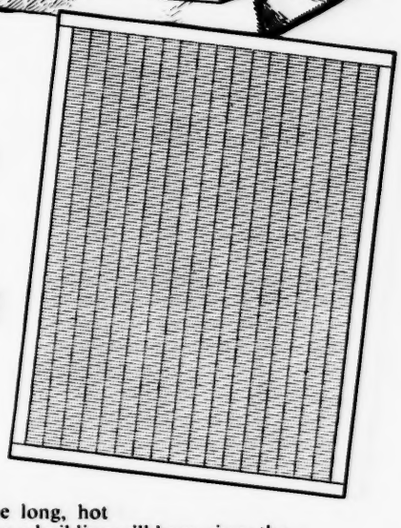
Clifford M. Lewis, who served two terms as director of the Stoker Manufacturers Association, has been named sales promotion manager of **Canton Stoker Corp.,** Canton, Ohio, manufacturers of industrial and commercial stokers. Mr. Lewis held the position of sales manager of Anchor Stove and Range Co., prior to joining the Canton Stoker organization in 1948.

S. Moroh

Sigmond Moroh has been named chief engineer of **National Air Conditioning Inc.,** Johnstown, Pa. Mr. Moroh will have complete responsibility for all engineering phases of the company's TEG Conditioner. Mr. Moroh previously served as consultant to the Research Corp. of New York on its triethylene glycol dehumidification equipment. Mr. Moroh has conducted extensive research on the application of triethylene glycol to air conditioning units. He supervised extensive tests on such equipment in the Climatometer Laboratory of The Pennsylvania State College and has done development and application work on the Research Corporation's all-steel cooling tower. Mr. Moroh holds a B.S. degree in physics from New York University and is a member of The American Physical Society.

Advancement of **John J. Kramer** to the position of vice president of the **American Thermal Industries, Inc.,** manufacturers of air conditioning equipment, has been announced. Mr. Kramer has been associated in the air conditioning and refrigeration field since 1936, and for the past two years has served as general manager for the Ameri-therm line.

KOOLSHADE DOES the WORK of 25,000 TONS of ICE on this building



Keep rooms up to 15° COOLER all summer with KOOLSHADE Sun Screen

KoolShade on 100 square feet of sun-exposed window has the cooling effect of a ton of ice each day. During the long, hot summer, KoolShade on a building will have given the same cool comfort as a tremendous block of ice.

KoolShade is the most effective shading device known. Its sturdy, paper-thin, bronze louvers, permanently set at a 17° angle, reflect and radiate up to 87% of the sun's heat rays outside windows—keep inside temperatures up to 15° cooler. Think what this means in terms of heat load reduction on air-conditioning installations—how much it adds to results from fan-type ventilating equipment. Visibility through KoolShade is excellent . . . there's no loss of light and air. Write today for a sample and for heat load data.

KOOLSHADE ADVANTAGES

Low maintenance cost—no painting . . . no fire or wind hazard . . . long-lasting . . . prevents sun-fading of furnishings . . . excellent insect protection . . . easy and inexpensive to install.

KOOLSHADE® SUN SCREEN

INGERSOLL STEEL DIVISION

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MAIL THIS COUPON TODAY FOR FREE SAMPLE

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Please send KoolShade sample and heat load data.

Name.....

Company.....

Address.....

City.....State.....

BW PRODUCT OF BORG-WARNER

Whether you've ever used "K" fittings or not, we ask you to pick one up and examine it closely. Notice the smooth walls inside and out. Notice the clean, sharp threads and chamfered entrances.

You can tell by looking at a "K" fitting that it's sound and symmetrical. If you sawed it in two, you'd find the walls of even thickness; the entire casting close-grained and free of defects.

Over the last sixty-odd years, "K" fittings have earned an enviable reputation for their fine quality of workmanship and material. They're the kind of fittings you like to install because they make up easily and stand up indefinitely. Specify them when you order.

THE 3000 SHAPES AND SIZES OF "K" CAST-IRON FITTINGS INCLUDE:
STANDARD AND EXTRA HEAVY SCREWED FITTINGS
STANDARD FLANGED FITTINGS
STANDARD AND EXTRA HEAVY COMPANION FLANGES
DRAINAGE AND SPRINKLER FITTINGS

PRECISION FITTINGS

KUHNS BROTHERS CO.
DAYTON 1, OHIO

COMBINED MARKET FACILITIES with Malleable Iron Fittings Company, Branford, Conn., and Kuhns Bros. Co., Dayton, Ohio

Promotion of V. W. Blackney to assistant to the president and appointment of **J. Roy Knox** as general manager of sales has been announced by **United States Radiator Corp.** Mr. Blackney was formerly director of sales in the distribution division. A graduate of Colgate University, he started with United States Radiator in 1916. Mr. Knox was formerly manager of the Pittsburgh branch. After graduation from the University of Pittsburgh, he joined United States Radiator in a sales promotion capacity.

B. W. Alvey has been appointed supervisor of water heater sales for **Frigidaire Division, General Motors Corp.** During the recent war, Mr. Alvey was associated with the War Production Board in Cincinnati, Ohio, as a product specialist and joined Frigidaire as a range and water heater sales representative in August, 1945.

Jan S. Irvine has been appointed manager of the Detroit branch office of **Owens-Corning Fiberglas Corp.** Although the present corporation was formed in 1938, Mr. Irvine has been continuously associated with the development and sale of Fiberglas products since 1931, when he joined the industrial materials division of Owens-Illinois Glass Co. Upon formation of the Fiberglas Corp. in 1938, he became sales manager of the air filter division, was manager of the New York office from 1940 to 1947, and sales manager of the transportation division from 1947 until his appointment as Detroit manager. In that post he succeeds E. E. French, who has resigned.

The **A. B. Judd Supply Co.** of Houston, Tex., has been appointed a distributor for **Tube-Turns, Inc.**

McQuay, Inc., announces the reappointment of the **Halberg Co.,** 3423 Farragut Rd., Brooklyn 10, N. Y., as the heating and air conditioning representative in Brooklyn, Long Island, and Staten Island, New York.

Air Conditioning Distributors, Inc., 791 Tremont St., Boston, announce their appointment as New England distributors of the De-Hu-Matic evaporative cooling unit manufactured by the Great National Air Conditioning Corp., a subsidiary of **United States Air Conditioning Corp.** of Minneapolis, Minn.

G. Curt Eggleston, regional field service engineer for **Delco Appliance Division of General Motors** since 1939, has been named southwestern regional manager for Delco Heat and Delco Water Systems sales.

J. J. Hall

John J. Hall, formerly vice president and general manager of sales, has been elected president of the **Richmond Radiator Co.,** an affiliate of the Reynolds Metals Co., with general offices at 19 E. 47th St., in New York City. Mr. Hall joined Richmond, manufacturers of plumbing fixtures, gas boilers and warm air furnaces, in May, 1944. Prior to his association with Richmond, Mr. Hall was vice president, general sales, of American Radiator and Standard Sanitary Corp. During the war Mr. Ha served as deputy vice chairman for industry operations c the War Production Board. Also announced by Richmon is the election of **P. E. Winnia** as executive vice presidet and **M. H. Temple** as vice president and treasurer. M Winnia, formerly vice president in charge of purchasin joined Richmond in January, 1945, as general purchasi agent. Mr. Temple, formerly treasurer, joined Richmo in March, 1945, as comptroller.

Air-Maze Corp. announces the appointment of **Minor Do** as factory representative for the state of Michigan. M Dow replaces Harry W. Lutz, who has been with the co pany for many years and is now changing locations. M Dow's office is at 412 Curtis Building, Detroit 2, Mich.

S. W. Corbin has been appointed assistant manager of the Industrial Divisions of **General Electric's Apparatus Department.** Mr. Corbin also is manager of the Resale Industries Division, a position he assumed in 1943 and will retain along with his new appointment. He served as sales manager of the machinery manufacturers section of the Industrial Department from 1937 to 1943.

C. M. Hatcher

Baker Refrigeration Corp., formerly Baker Ice Machine Co., Inc., has announced the appointment of **C. M. Hatcher** to the newly created post of advertising and sales promotional manager.

For the past year, Mr. Hatcher was associated with the Coca-Cola Bottling Works of Nashville, Tenn., as advertising manager. Prior to this he was advertising and sales promotion manager of Universal Cooler Division of International Detrola Corp. of Marion, Ohio, who also manufacture refrigeration products. Announcement is also made of the appointment of **Walter T. Martin** as industrial engineer at Baker. This appointment is effective immediately and Mr. Martin has already assumed his new post at Baker's South Windham, Maine, plant. He will have complete supervision of all time, motion, and methods engineering.

At the **Tenth Annual Meeting of the Propeller Fan Manufacturers' Association,** held at Atlanta, Georgia, February 16-17, 1949, the following officers were elected for the ensuing year: W. H. Holt, president; Lyman C. Reed, vice president; L. O. Monroe, secretary-treasurer. Mr. Holt is manager of Fan Merchandise and Standard Apparatus Department of the Buffalo Forge Co., Buffalo, N. Y., and Mr. Reed is president of Reed Unit-Fans, Inc., New Orleans, Louisiana.

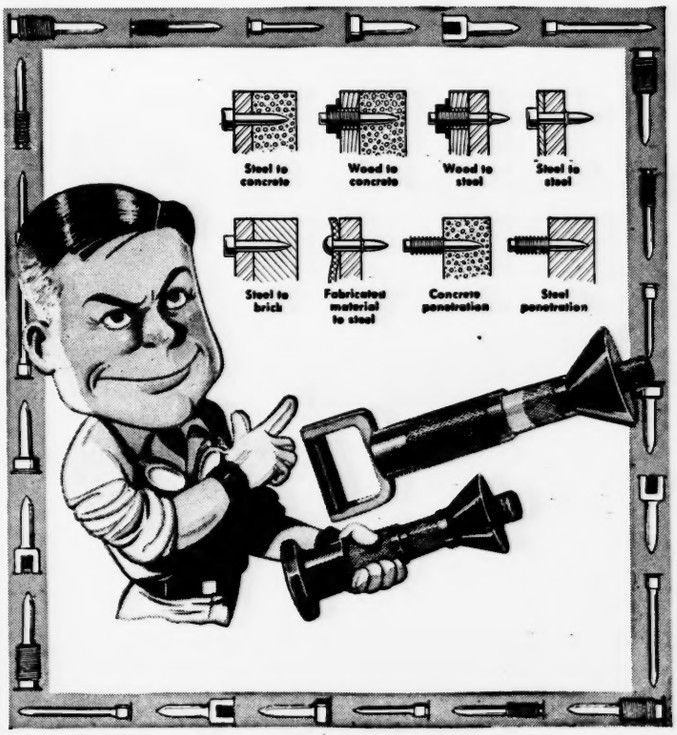
At the Twenty-Third Annual Meeting of the **Industrial Unit Heater Association,** held at Chicago, Illinois, January 24, 1949, the following officers were elected for the ensuing year: H. S. Wheller, president; L. D. Mandell, vice president; L. O. Monroe, secretary-treasurer. Mr. Wheller is president of the L. J. Wing Manufacturing Co., N. Y., and Mr. Mandell is vice president of the C. A. Dunham Co., Chicago, Ill.

At the Thirty-Second Annual Meeting of the **National Association of Fan Manufacturers,** held at Hot Springs, Virginia, March 3-4, 1949, the following officers were elected for the ensuing year: Edgar F. Wendt, president; R. A. Wasson, vice president; L. O. Monroe, secretary-treasurer. Mr. Wendt is president of the Buffalo Forge Co., Buffalo, N. Y., and Mr. Wasson is vice president and general manager of the Clarage Fan Co., Kalamazoo, Mich.

INDUSTRIAL DEGREE-DAYS

February, 1949

City	55F Base	45F Base
Baltimore, Md.	330	115
Buffalo, N. Y.	650	370
Chicago, Ill.	707	428
Cleveland, Ohio	582	312
Detroit, Mich.	682	402
Indianapolis, Ind.	558	282
New York, N. Y.	456	210
Philadelphia, Pa.	407	173
Pittsburgh, Pa.	427	184
St. Louis, Mo.	502	239



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the multi-job man!

Fastening jobs like those illustrated are all in a day's work for JOE RAMSETTER. With his light, self-powered RAMSET TOOL and 63 sizes of pins and studs, he can set up to 50 fasteners per hour, to cut costs and finish the job faster.

No chipping, no drilling, no plugging. No electric or air lines. Prepare the RAMSET TOOL in 30 seconds. Then, place it against the work and RAM! The fastener is set instantly, tightly, easily. We teach any alert, careful workman to "RAMSET", in 30 minutes.

For fastenings in steel, concrete and other hard-to-work materials, RAMSET pays big dividends in time and money. Use the coupon for complete information. *Stemco Corporation, Cleveland 16 (Rocky River), Ohio.*

In Canada—Globe Machine Tools, Batawa, Ontario

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FASTENING SYSTEM

HV-4

Stemco Corporation,
Cleveland 16 (Rocky River), Ohio
Please send details and arrange for demonstration of RAMSET FASTENING SYSTEM.

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AUTOMATIC SAFETY SHUT-OFF VALVE
for
COMMERCIAL AND INDUSTRIAL APPLICATIONS

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TYPE V-110
MANUAL RESET VALVES

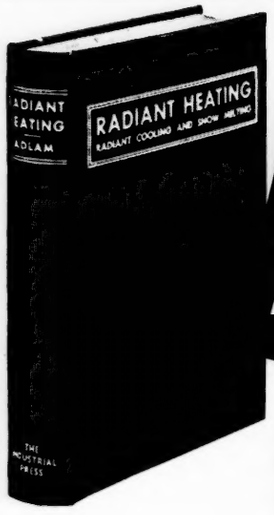
Controls air, gas, oil, steam or water. They are unaffected by dirty, viscous or high temperature fluids. Highly desirable where attention of attendant is required before resuming service. V-110 is equipped with *trip-free* mechanism; if the safe electric limit control condition does not exist, it can neither be opened nor held open, once the valve has automatically closed it must be reopened *manually*. Usable in any temperature, pressure or flow control circuit or as a flame safety control.

TWO-WIRE • CURRENT FAILURE • EXTERNAL OPERATOR • ADJUSTABLE • MAXIMUM FLOW

Available in ½" to 6" I.P.S.

For complete specifications request literature. 51-4

GENERAL CONTROLS
801 ALLEN AVENUE GLENDALE 1, CALIF
Manufacturers of Automatic Pressure Temperature & Flow Controls
FACTORY BRANCHES: BIRMINGHAM 3 • BOSTON 16 • CHICAGO 35 • DALLAS 2 • DENVER 10 • DETROIT 31 • CLEVELAND 15 • HOUSTON 2 • KANSAS CITY 2 • NEW YORK 17 • PHILADELPHIA 40 • PITTSBURGH 22 • SAN FRANCISCO 7 • SEATTLE 1
DISTRIBUTORS IN PRINCIPAL CITIES



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Here are the basic principles, the experience-proved facts, the practical working data on applications of radiant energy for heating and cooling, and embedded pipe for snow removal. Everyone interested in this heating method will find the answers to his questions in this thorough treatise. Covering every phase of the subject, from first principles to actual step-by-step design and installation procedure, this volume is a dependable manual of ready-to-use information on a timely and important subject.

THE INDUSTRIAL PRESS
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Canadian Degree-Days for February, 1949*

City	February		Cumulative, Sept. 1 to Feb. 28	
	1949	Normal	1948-49	Normal
Calgary, Alta.	1739	1355	7204	6666
Charlottetown, P.E.I.	1277	1338	5243	5666
Crescent Valley, B. C.	1218	1112	6323	5743
Edmonton, Alta.	1876	1501	7876	7299
Fort William, Ont.	1669	1582	6862	7204
Grande Prairie, Alta.	1960	1456	8371	7456
Halifax, N. S.	1090	1170	4563	5068
London, Ont.	1081	1240	4728	5253
Medicine Hat, Alta.	1722	1406	7063	6438
Moncton, N. B.	1294	1392	5554	6106
Montreal, P. Q.	1249	1460	5185	6108
North Bay, Ont.	1400	1492	6126	6653
Ottawa, Ont.	1291	1459	5462	6382
Penticton, B. C.	1179	969	5620	4779
Porquis Junction, Ont.	1694	1764	7015	8064
Prince George, B. C.	1655	1305	7512	6677
Quebec City, P. Q.	1336	1481	5601	6688
Regina, Sask.	1943	1764	8236	8137
St. John, N. B.	1182	1266	5038	5652
Saskatoon, Sask.	2013	1635	8352	7911
Toronto, Ont.	985	1206	4288	5154
Vancouver, B. C.	868	736	4413	3797
Victoria, B. C.	762	689	3871	3414
Windsor, Ont.	972	1148	4218	4877
Winnipeg, Man.	1994	1775	7762	8091

*These data are supplied through the courtesy of the Meteorological Division, Air Service Branch, Department of Transport, Canada.

COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

POWER CONFERENCE — 1949 Midwest Power Conference, sponsored by Illinois Institute of Technology, and including sessions on heating and air conditioning and on the heat pump (9:00 a.m. and 10:30 a.m., respectively, on April 20) at Hotel Sherman, Chicago. Conference director, Roland A. Budenholzer, Illinois Institute of Technology, 3300 South Federal St., Chicago 16, Illinois. ..... **APRIL 18-20, 1949.**

PROFESSIONAL ENGINEERS CONVENTION—22nd annual convention, The New York Society of Professional Engineers, Inc., at Hotel New Yorker, New York. E. J. Quirin, vice president, Frederic R. Harris, Inc., 27 William Street, New York 5, N. Y. ..... **APRIL 21-23, 1949.**

ANTHRACITE CONFERENCE—7th annual Anthracite Conference at Lehigh University, Bethlehem, Pa. Prof. A. Copeland Callen, head of Department of Mining Engineering, Lehigh University. ..... **MAY 5-6, 1949.**

L. P. GAS CONVENTION AND SHOW—Annual convention and trade show of the Liquefied Petroleum Gas Association, at Palmer House, Chicago, Ill. Howard D. White, executive vice president, 11 S. LaSalle St., Chicago 3, Ill. .. **MAY 9-11, 1949.**

INSTRUMENT MEETING — Fourth annual spring meeting, Instrument Society of America, at Royal York Hotel, Toronto, Ont., Canada. Secretary of Society, 1117 Wolfendale St., Pittsburgh 12, Pa. ..... **MAY 12-13, 1949.**

OIL BURNER SHOW—National Oil Heat Exposition and annual convention, at Mechanics Hall, Boston, Mass. Sponsored by Oil-Heat Institute of America, Inc., 6 E. 39th St., New York 16, N. Y. ..... **MAY 16-20, 1949.**

STEAM SPECIALTY MEETING — Annual meeting of the National Steam Specialty Club, at Skytop Lodge, Skytop, Pa. J. M. Naab, vice president, Leslie Co., Lyndhurst, N. J. ..... **MAY 18-20, 1949.**

NDHA MEETING—Annual meeting, National District Heating Association, at The New Ocean House, Swampscott, Mass. John F. Collins, Jr., secretary of Association, 827 N. Euclid Ave., Pittsburgh 6, Pa. .....**MAY 24-27, 1949**

PLUMBERS CONVENTION AND SHOW—1949 convention and exposition of the National Association of Master Plumbers, at Cleveland Public Auditorium, Cleveland, Ohio. Secretary of Association, 1106 K St., N.W., Washington 5, D. C. .....**MAY 30-JUNE 2, 1949.**

ASRE MEETING—36th spring meeting, American Society of Refrigerating Engineers, on the Steamer Richelieu, from Montreal, Quebec, for the Saguenay River cruise. M. C. Turpin, secretary of the Society, 40 West 40th Street, New York, N. Y. .....**JUNE 5-9, 1949.**

CONTRACTORS CONVENTION — 60th annual convention, Heating, Piping & Air Conditioning Contractors National Association, at Hotel Statler, Detroit, Mich. Joseph C. Fitts, secretary of Association, 1250 Avenue of the Americas, New York 20, N. Y. .....**JUNE 8-10, 1949.**

STOKER MEETING—Annual meeting, Stoker Manufacturers Association, at French Lick Springs, Ind. Headquarters not announced. Marc G. Bluth, executive secretary of Association, 307 N. Michigan Ave., Chicago 1, Ill. .....**JUNE 13-14, 1949.**

I-B-R SHORT COURSE—Third I-B-R short course on steam and hot water heating systems, sponsored by the University of Illinois and I-B-R, on the university campus at Champaign-Urbana, Ill. .....**JUNE 14-17, 1949.**

ASHVE MEETING—Semi-annual meeting, American Society of Heating and Ventilating Engineers, at Hotel Nicollet, Minneapolis, Minn. A. V. Hutchinson, secretary, 51 Madison Ave., New York, N. Y. .....**JUNE 20-22, 1949.**

WARM AIR CONVENTION — Mid-year convention of the National Warm Air Heating and Air Conditioning Association, at Edgewater Beach Hotel, Chicago, Illinois. Managing director, George Boeddener, 145 Public Square, Cleveland 14, Ohio. .....**JUNE 21-22, 1949.**

INSTRUMENT CONVENTION—1949 convention of the Instrument Society of America, at Municipal Auditorium, St. Louis, Mo. John McCaffery, assistant executive secretary of Society, 1117 Wolfendale St., Pittsburgh 12, Pa. .....**SEPTEMBER 12-16, 1949.**

PLUMBING AND HEATING MEETING — Annual meeting of the Plumbing and Heating Industries Bureau, at Palmer House, Chicago, Ill. Norman J. Radder, secretary of Bureau, 35 E. Wacker Dr., Chicago 1, Ill. .....**OCTOBER 5, 1949.**

WELDING AND METALS MEETING—1949 Annual Meeting of the American Welding Society, in conjunction with the National Metals Congress, tentatively at Cleveland Hotel, Cleveland, Ohio. Secretary of Society, 33 W. 39th St., New York 18, N. Y. .....**OCTOBER 16, 1949.**

AGA CONVENTION—1949 annual convention, American Gas Association, at Chicago, Ill. For details, contact secretary, AGA, 420 Lexington Ave., New York 17, N. Y. .....**OCTOBER 17-20, 1949.**

PUBLIC HEALTH MEETING — 77th annual meeting of the American Public Health Association, and meetings of related organizations, at the Hotels Statler and New Yorker, New York City. Dr. Reginald M. Atwater, executive secretary of the Association, 1790 Broadway, New York, N. Y. .....**OCTOBER 24-28, 1949**

REFRIGERATION SHOW—6th All-Industry Refrigeration and Air Conditioning Exposition, at Atlantic City, New Jersey. R. K. Hanson, show director, REMA, 1107 Clark Building, Pittsburgh 22, Pennsylvania. .....**NOVEMBER 14-18, 1949.**

ASRE CONVENTION—46th annual convention, American Society of Refrigerating Engineers, at Edgewater Beach Hotel, Chicago, Ill. M. C. Turpin, secretary of Society, 40 W. 40th St., New York, N. Y. .....**DECEMBER 4-7, 1949.**

HEATING AND VENTILATING SHOW—Southwest Air Conditioning Exposition of the International Heating and Ventilating Exposition, State Fair Grounds, Dallas, Texas, under the auspices of the American Society of Heating and Ventilating Engineers. Charles F. Roth, manager of the International Exposition Company, Grand Central Palace, New York 17, N. Y. .....**JANUARY 23-27, 1950.**

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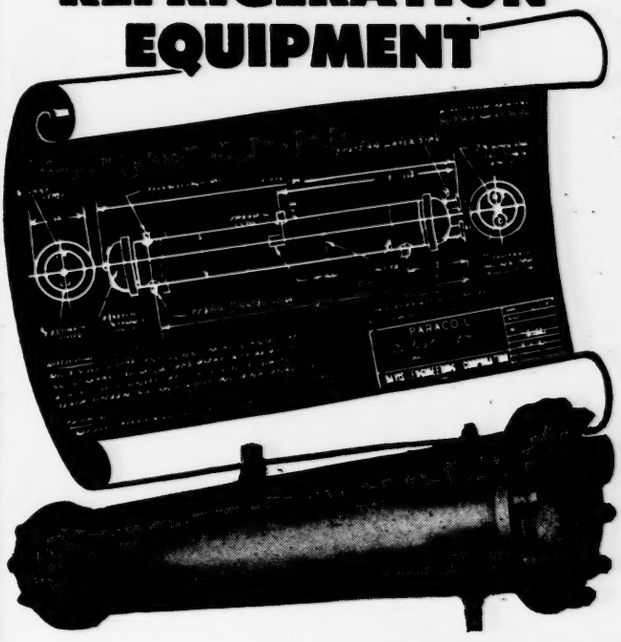

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